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TETRA TECH

Andre Baker
Environmental Scientist

November 26, 2019

Mr. Paul Ruesch
On-Scene Coordinator
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Subject: **Sampling and Analysis Plan (Revision 0)**
Joliet Chemical Fire PRP Cleanup Site
20604 Amherst Court
Joliet, Will County, Illinois 60433
EPA Contract No.: 68-HE-0519-D0005
Task Order-Task Order Line Item No.: 0069-0002AJ001
Document Tracking No.: 0106

Dear Mr. Ruesch:

The Tetra Tech, Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) is submitting, for your review and comment, the enclosed Sampling and Analysis Plan (Revision 0) for the Joliet Chemical Fire PRP Cleanup site located at 20604 Amherst Court in Joliet, Will County, Illinois. This plan summarizes surface soil sampling and split sampling of groundwater samples at the site.

If you have any questions regarding this plan, please call me at (630) 379-3749.

Sincerely,

Andre Baker

Andre Baker
Project Manager

Enclosure

cc: Kevin Scott, Tetra Tech Program Manager
TO-TOLIN File

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SAMPLING AND ANALYSIS PLAN
JOLIET CHEMICAL FIRE PRP CLEANUP SITE
JOLIET, WILL COUNTY, ILLINOIS

Revision 0

Prepared for

U.S. Environmental Protection Agency
Superfund and Emergency Management Division
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

Submitted by

Tetra Tech, Inc.
1 South Wacker Drive, 37th Floor
Chicago, Illinois 60606

EPA Contract No.: 68-HE-0519-D0005

Task Order-Task Order Line Item No.: 0069-0002AJ001
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November 26, 2019

Prepared by

Andre Baker
Project Manager

Approved by

Joseph Gawarzewski
START QC Reviewer

CONTENTS

1.0 INTRODUCTION

Under the Superfund Technical Assessment and Response Team (START) Contract 68-HE-0519-D0005, Task Order (TO)-Task Order Line Item Number (TOLIN) No. 0069-0002AJ001, the U.S. Environmental Protection Agency (EPA) contracted Tetra Tech, Inc. (Tetra Tech) to prepare a sampling and analysis plan (SAP) for sampling events to be conducted at the Joliet Chemical Fire PRP Cleanup site located in Joliet, Will County, Illinois. The purpose of this SAP is to specify the type, number, and location of samples to be collected, as well as provide the schedule and sample collection methods.

Activities and procedures discussed and described in this SAP will be conducted in accordance with Tetra Tech's EPA-approved August 2019 START Quality Assurance Project Plan (QAPP) to ensure that data quality objectives (DQO) are met (Tetra Tech 2019). Information obtained from sampling activities will be used to determine: (1) if surface soils in the roadside drainage ditch, located adjacent to the site to the north, have been impacted with total petroleum hydrocarbons (TPH) as diesel range organics (DRO); (2) if surface soils around the MPG Industries former manufacturing plant and in the soybean field north of Interstate 80 (I-80) are still impacted with volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), and TPH after excavation of contaminated soil; and (3) if residential wells surrounding the site have been impacted with VOCs and SVOCs.

2.0 SCOPE OF WORK

During the sampling event, START will complete the following tasks:

- Collect five (5) five-point composite surface soil samples from the roadside drainage ditch located adjacent and north of the site.
- Collect confirmation surface soil samples around the former manufacturing building and in the soybean field north of I-80 to be co-located with soil borings advanced by the potentially responsible party's (PRP) contractor.
- Collect groundwater samples from potable wells at up to 23 residences.
- Document sampling activities, including recording and photographing sampling locations.
- Package and ship samples to a START-contracted laboratory.
- Coordinate the laboratory analysis of soil samples for TPH as DRO.
- Coordinate the laboratory analysis of soil samples for TPH, VOCs, and SVOCs.
- Coordinate the laboratory analysis of water samples for VOCs and SVOCs.
- Document and summarize the findings from sampling activities in a site assessment report.

This SAP describes the sampling, analytical, and quality assurance/quality control (QA/QC) requirements for the November and December 2019 sampling events. Figures are provided in Appendix A. Tables 1 through 7 are presented within the text and Tables 8, 9, and 10 are included in Appendix B. Tetra Tech standard operating procedures (SOP) to be used during this investigation are provided in Appendix C. An EPA SOP is included as an attachment to this SAP.

3.0 PROJECT TEAM

The personnel listed in Table 1 will be involved in planning or technical activities for this site. The EPA On-Scene coordinator (OSC) and each member of the field team will receive a copy of this SAP and copies will be retained in the site file.

TABLE 1 – PROJECT TEAM

Personnel	Title	Organization	Phone Number	Email
Paul Ruesch	OSC	EPA	Non-responsive [redacted]	ruesch.paul@epa.gov
Andre Baker	Project Manager	START	[redacted]	andre.baker@tetratech.com
Brendan Martin	Field Team Leader	START	[redacted]	brendan.martin@tetratech.com
Kris Schnoes	QA Manager	START	[redacted]	kris.schnoes@tetratech.com

Notes:
EPA = U.S. Environmental Protection Agency
OSC = On-Scene Coordinator
QA = Quality assurance
START = Superfund Technical Assessment and Response Team

4.0 SITE BACKGROUND

This section describes the site location and history.

4.1 SITE LOCATION

The Joliet Chemical Fire PRP Cleanup site is located at 20604 Amherst Court in Joliet, Will County, Illinois. The geographic coordinates of the site are approximately 41.513060º north latitude and 88.019551º west longitude. The site includes the MPG Industries, Inc. facility and four adjacent impacted properties. Figure 1 shows the site location and Figure 2 provides the site layout (see Appendix A). The area surrounding the facility is mixed, with agricultural, commercial, and residential properties nearby. A residential neighborhood is located 0.5 mile west and another residential neighborhood is located 0.75 mile northeast of the site.

4.2 SITE HISTORY

A fire at the MPG Industries, Inc. facility on August 3, 2019, resulted in the total loss of the manufacturing plant and caused damage to an adjacent building. During the fire response, fire suppression water migrated from the site into the drainage ditch along the south side of I-80 and into a soybean field to the north of I-80.

EPA conducted emergency containment and removal activities to stabilize the site and prevent any further releases of substances that could pose a threat to human health or the environment.

The facility utilized petroleum-based feed stock to produce alkanolamides, anti-wear additives, corrosion inhibitors, and emulsifiers. The owners/operators of the MPG Industries, Inc. facility have stated that the majority of the materials stored and utilized at the facility were classified as non-hazardous with the exception of three products identified as Monoethanolamine (MEA), Dry Film, and Methoxypropylamine (MOPA). These three products are considered hazardous based on the characteristics of ignitability and corrosivity. In addition, the facility produced products for embalming services that were stored and prepared in a warehouse building directly adjacent to the main plant. The facility provided EPA with 79 safety data sheets (SDS) for chemicals that were, at some point, stored at the facility. EPA's review of these SDSs identified 44 toxic chemicals, 43 ignitable chemicals, 31 corrosive chemicals, and 5 reactive chemicals.

EPA demobilized the Emergency and Rapid Response Services (ERRS) contractor and completed emergency response and stabilization activities on August 22, 2019. The site was secured and on October 21, 2019, the PRP began work on the cleanup, as stipulated by an Administrative Settlement Agreement and Order on Consent with EPA dated October 9, 2019. The entrance to the facility is locked and the facility remains under 24-hour surveillance.

5.0 PROPOSED SCHEDULE

Sampling activities are scheduled for November and December 2019. The preliminary laboratory results for TPH-DRO are anticipated to be available 24 hours after the laboratory receives the samples. The preliminary laboratory results for VOCs, SVOCs, and TPH are anticipated to be available 10 days after the laboratory receives the samples.

All laboratory analytical data will be validated by a START chemist when the full laboratory reports become available. Validated analytical results and other findings will be provided to the EPA in a letter report. The anticipated schedule is outlined in Table 2 below.

TABLE 2 - PROPOSED SCHEDULE

Activities	Anticipated Date(s) of Initiation	Anticipated Date of Completion	Deliverables	Deliverable Due Date
SAP Preparation	November 6, 2019	November 27, 2019	SAP	November 27, 2019
Sample Collection	November 2019	December 2019	Log Books	Not applicable
Laboratory Analysis	November/December 2019	December 2019	Laboratory Analytical Reports	2 weeks after submittal
Data Validation	December 2019	January 2020	Data Validation Reports	1 week after receiving the final laboratory data package
Draft Project Report	January 2020	January/February 2020	Draft Letter Report	2 weeks after submitting the data validation reports
Final Project Report	Upon receipt of comments to the draft report	1 week after receipt of client comments	Final Letter Report	TBD

Notes:
SAP = Sampling and Analysis Plan
TBD = To be determined

6.0 SAMPLE COLLECTION

The following sections describe methods for sample collection.

6.1 ROADSIDE DRAINAGE DITCH SOIL SAMPLING

EPA and START will collect soil samples from five locations in the roadway drainage ditch adjacent to the site to the north. The ditch will be equally divided into five 25-foot by 100-foot grids. Figure 3 in Appendix A displays the proposed sampling locations.

START will collect surface soil samples using a stainless-steel hand auger in accordance with Tetra Tech SOP No. 005-3, "Soil Sampling." START will collect five-point composite soil samples from 0 to 6 inches below ground surface (bgs) from each pre-determined grid.

The five aliquots for each sample will be collected from the same depth interval and consist of equal volume. Aliquots will be collected in a 5-point dice pattern, with one aliquot collected at the approximate center of the grid, and the remaining four aliquots collected from points approximately equal distance from the center to each corner of the grid. At each sample grid, the five sample aliquots will be combined into a resealable plastic bag. Each bag and sample jar will be labeled to identify the site and property ID; for example, MPG Industries (MPGI), Property (I80), matrix (Soil), sample location (01 through 05), and date (MMDDYY). Field duplicates will be assigned a consecutive number and noted a duplicate in the field notes. Soil samples will be identified by a unique sample identification number as described in Table 3 below.

TABLE 3 - EXAMPLE SAMPLE NOMENCLATURE

Site ID	Property ID	Matrix	Location Identifier	Date	Example Identification
MPGI	I80	Soil	01 02 03 04 05	112719 – November 27, 2019	MPGI-I80-Soil-01-112719

Notes:
I80 = Interstate 80
MPGI = MPG Industries

Once the five aliquots have been placed in a labeled plastic bag, the soil in each bag will be homogenized by breaking up large chunks of soil and mixing it within the bag. Soil will then be placed in a 4-ounce jar for laboratory analysis for TPH as DRO by the subcontracted laboratory. START will also collect QA/QC samples, as described in Section 9.0. After sampling, open holes at each sample location will be filled with clean topsoil. Anticipated laboratory sample totals are provided in Table 8 in Appendix B. Analytical methods, volumes, containers, preservation, holding times are provided in Table 10 in Appendix B.

Sample locations will be recorded using a global positioning system (GPS) device and noted in the site logbook in accordance with Tetra Tech SOP No. 024-2, "Recording Notes in Field Logbooks." Sampling activities, including site restoration, will be documented with photographs.

6.2 CONFIRMATION SOIL SAMPLING

After excavation of impacted surficial soils around the former MPG Industries manufacturing plant and in the soybean field north of I-80, START will collect surface soil samples from 18 sample locations to be co-located with soil borings that will be advanced by the PRP's consultant (Appendix A, Figures 4 and 5).

START will collect surface soil samples using a stainless-steel trowel or shovel in accordance with Tetra Tech SOP No. 005-3, "Soil Sampling." START will also collect grab soil samples from 0 to 3 inches bgs from each pre-determined sample location. Samples will be placed directly into 4-ounce sample jars.

Each sample jar will be labeled to identify the site and property ID, matrix, sample location, and date. Field duplicates will be assigned a consecutive number and noted a duplicate in the field notes. Soil samples will be identified by a unique sample identification number, as described in Table 4 below.

TABLE 4 - EXAMPLE SAMPLE NOMENCLATURE

Site ID	Property ID	Matrix	Location Identifier	Date	Example Identification
MPGI	North East South	Soil	01 through 12	112719 – November 27, 2019	MPGI-North-Soil-01-112719
MPGI	SF	Soil	09 10A 10B 10C 11 12	112719 – November 27, 2019	MPGI-SF-Soil-09-112719

Notes:
MPGI = MPG Industries
SF = Soybean field

START will collect QA/QC samples, as described in Section 9.0. After sampling, open holes at each sample location will be filled with clean topsoil. All samples will be sent to the subcontracted laboratory for laboratory analysis for TPH, SVOCs, and VOCs. Anticipated laboratory sample totals are provided in Table 8 in Appendix B. Analytical methods, volumes, containers, preservation, holding times are provided in Table 10 in Appendix B.

Sample locations will be recorded using a GPS device and noted in the site logbook in accordance with Tetra Tech SOP No. 024-2, "Recording Notes in Field Logbooks." Sampling activities, including site restoration, will be documented with photographs.

6.3 RESIDENTIAL WELL SAMPLING

START will collect split groundwater samples with the PRP's contractor from potable wells at up to 23 residences located within a 400-foot radius of the site. Residential well samples will be collected in accordance with Tetra Tech SOP 061-2, "Field Measurement of Groundwater Indicator Parameters," and in accordance with EPA SOP No. SESDPROC-305-R3, "Potable Water Supply Sampling." This EPA SOP is not listed in Tetra Tech's August 2019 START QAPP, but is included as an attachment to this SAP.

Samples will be collected from each well prior to any treatment systems from an exterior spigot. The spigot will first be purged at a high flow rate and then put to a lower rate to collect parameters for stabilization. Parameters will be collected every 3 to 5 minutes until three consecutive readings are within stabilization ranges presented in Table 5 below.

TABLE 5 – STABILIZATION CRITERIA FOR WATER QUALITY PARAMETERS

Parameter	Stabilization Criteria
pH	+/- 0.1 units
Specific Conductance	+/- 10 percent
Oxidation-Reduction Potential	+/- 20 millivolts
Dissolved Oxygen	+/- 0.3 milligrams per liter or +/- 10 percent
Turbidity	+/- 10 percent or below 10 NTU

Note:
NTU = Nephelometric Turbidity Units

Each sample jar will be labeled to identify the site and property ID, matrix, sample location, and date. Field duplicates will be assigned a consecutive number and noted as a duplicate in the field notes. Groundwater samples will be identified by a unique sample identification number as described in Table 6 below.

TABLE 6 - EXAMPLE SAMPLE NOMENCLATURE

Site ID	Property ID	Matrix	Location Identifier	Date	Example Identification
MPGI	01 through 23	Water	RW	112719 – November 27, 2019	MPGI-01-Water-RW-112719

Notes:
MPGI = MPG Industries
RW = Residential well

START will collect one duplicate sample for every 10 samples collected and one MS/MSD sample for every 20 samples collected. One laboratory-supplied trip blank will accompany bottles and samples to and from the laboratory. All water samples will be sent to the subcontracted laboratory for analysis for SVOCs and VOCs. Anticipated laboratory sample totals are provided in Table 9 in Appendix B. Analytical methods, volumes, containers, preservation, holding times are provided in Table 10 in Appendix B.

7.0 DECONTAMINATION

Investigation-derived waste (IDW), including personal protective equipment (PPE), dedicated sampling equipment, and supplies, will be double-bagged and disposed of as dry industrial waste in accordance with the EPA Office of Emergency and Remedial Response (OERR), Management of Investigation-Derived Waste during Site Inspections (Document No. EPA/540/G-91/009) (EPA 1991).

Non-disposable equipment (such as the hand auger and trowel) will be decontaminated between sampling locations following the procedures in Tetra Tech SOP No. 002-4, "General Equipment Decontamination." Decontamination water use will be kept to a minimum, and typically 5 gallons of rinsate water is generated. The rinsate water will be disposed of on site by evaporation over a hard surface.

Equipment rinsate blank samples will be collected at a frequency of one per sampling event. Equipment rinsate blanks will be collected by slowly rinsing the decontaminated equipment with laboratory-grade deionized water while simultaneously collecting the used rinse water in a laboratory-provided container. Rinsate blank samples will be delivered to the designated laboratory under chain-of-custody for analysis for TPH and TPH-DRO. The table below lists equipment rinsate blank container and analytical requirements.

TABLE 7 - EQUIPMENT RINSATE BLANK CONTAINER AND ANALYTICAL REQUIREMENTS

Matrix	Containers (Number, Size, and Type	Analytical Parameter(s)	Analytical Method	Preservation Requirement	Holding Time
Water	One 1-L amber glass bottle	TPH-DRO	SW860-8015	Cool to 4 °C ± 2 °C immediately after collection	7 days
Water	One 1-L amber glass bottle	TPH	SW860-8015	Cool to 4 °C ± 2 °C immediately after collection	7 days

Notes:
C = Celsius
DRO = Diesel range organics
L = Liter
TPH = Total petroleum hydrocarbons

8.0 SAMPLE HANDLING

Sampling locations will be noted in the site logbook in accordance with Tetra Tech SOP No. 024-2, "Recording Notes in Field Logbooks." The samples collected will be labeled, packaged, and shipped in accordance with procedures outlined in Worksheets #26 and 27 of Tetra Tech's START QAPP (Tetra Tech 2019) and Tetra Tech SOP No. 019-7, "Packaging and Shipping Samples."

9.0 QUALITY ASSURANCE/QUALITY CONTROL

QA/QC requirements will be adapted to project-specific conditions. The Tetra Tech project manager, Andre Baker, will be responsible for ensuring that sample quality and integrity are maintained and that sample label and documentation procedures are conducted in accordance with the START QAPP and this SAP. When the analytical results are received, START will review the laboratory data packages for completeness and will conduct Stage 4 data validation in accordance with the EPA Office of Superfund Remediation and Technology Innovation, National Functional Guidelines for Organic Superfund Methods Data Review (Document No. EPA/540/R-2017/002) (EPA 2017).

QC samples will be collected to evaluate the field sampling and decontamination methods, and the overall reproducibility of the laboratory analytical results. Specifically, QC samples will be collected at the following frequencies:

- Field duplicate samples
  - 1 per 10 investigative samples
- Matrix spike/matrix spike duplicate samples
  - 1 per 20 investigative samples
- Equipment rinsate sample
  - 1 per sampling event

Field duplicate samples will be processed, stored, packaged, and analyzed by the same methods as the investigative samples. Sample nomenclature, specific to QC samples, is described in Section 6.0 of this SAP. Based on a START chemist’s validation of analytical results, corrective actions may include resampling, reassessment of the laboratory’s methods, or assignment of data qualifiers to the laboratory results.

REFERENCES

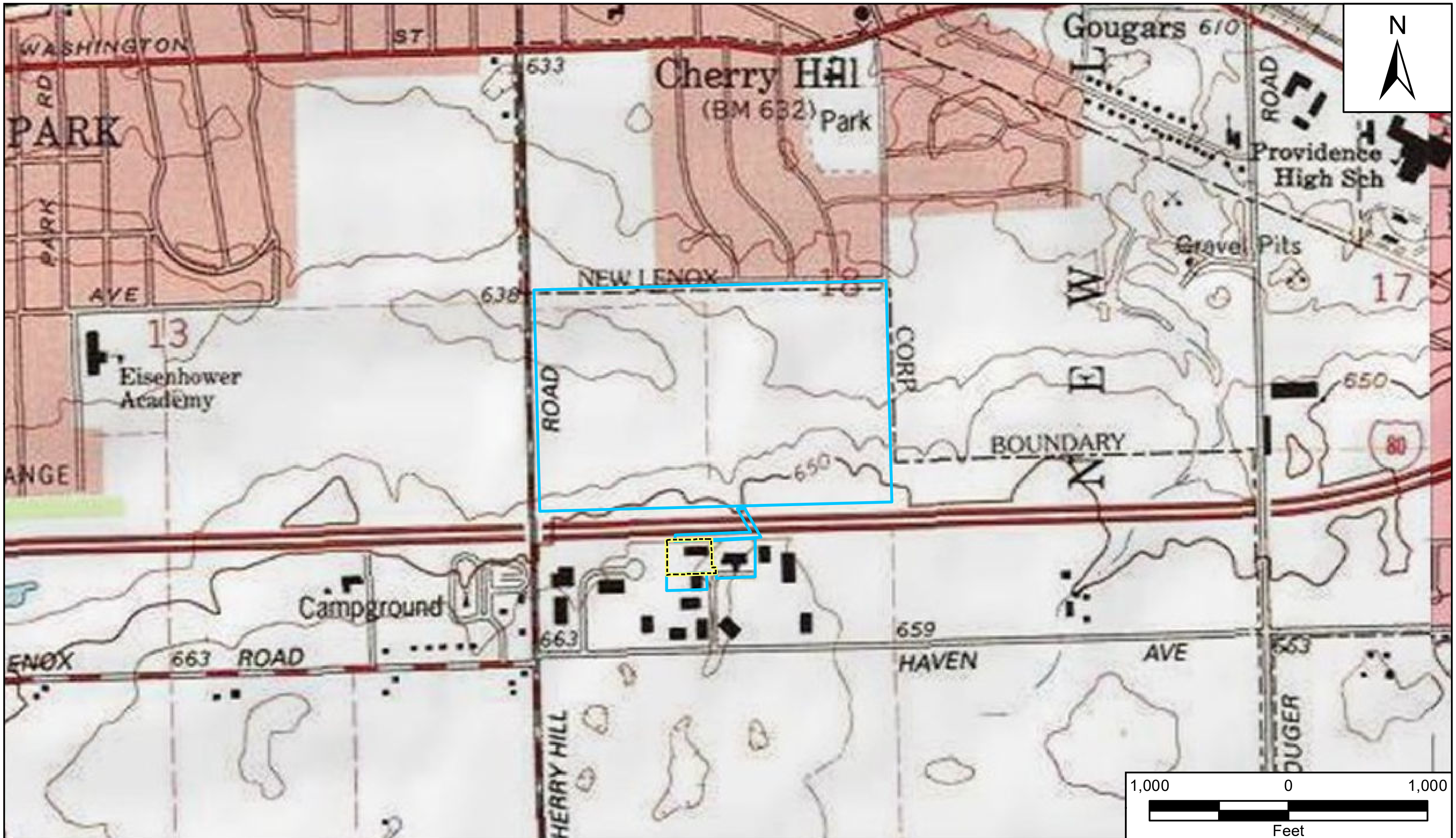
Tetra Tech Inc. (Tetra Tech) 2019. "Quality Assurance Project Plan (QAPP) for START." August.

U.S. Environmental Protection Agency (EPA). 1991. "Management of Investigation Derived Waste during Site Inspections." Office of Emergency and Remedial Response. Washington, D.C. EPA/540/G-91-009. May.

EPA. 2017. National Functional Guidelines for Organic Superfund Methods Data Review. Office of Superfund Remediation and Technology Innovation. OLEM 9355.0-136. EPA/540/R-2017/002. January.

APPENDIX A

Site Figures



Legend

Approximate Site Boundary - MPG Industries

Affected Property

Joliet Chemical Fire PRP Cleanup
20604 Amherst Court
Joliet, Will County, Illinois

Figure 1
Site Location Map

TETRA TECH

Prepared For: USEPA | Prepared By: Tetra Tech

File Path: G:\G\G9031-START V\Illinois\Joliet Chemical Fire\mxd\Fig1 - Site Location.mxd

Date Saved: 11/25/2019

EPA Contract No.: 68-HE-0519-D005

TO-TOLIN: 0069-0002AJ001

Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
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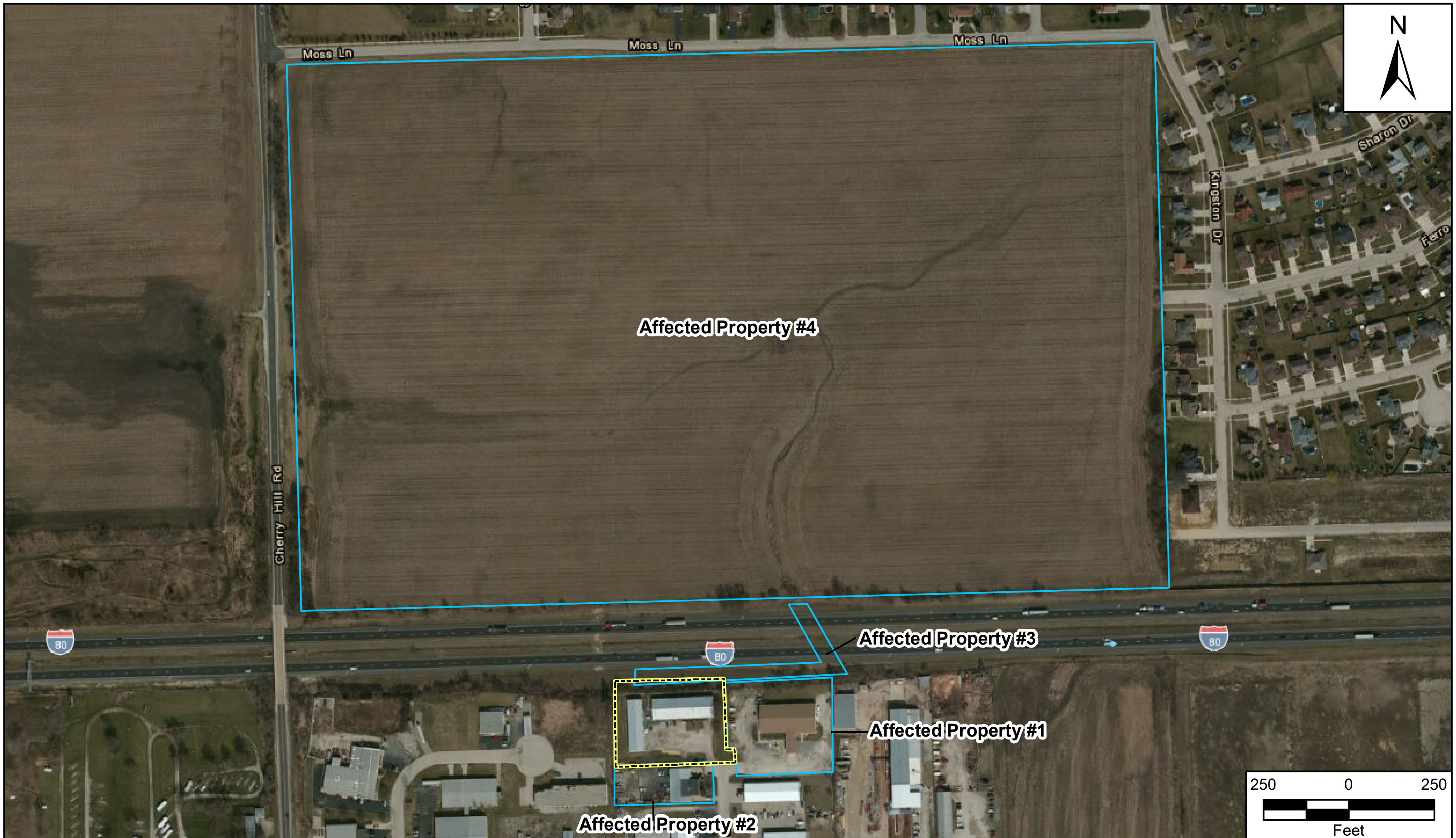
Datum:North American 1983 Units: Foot US



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Approximate Site Boundary - MPG Industries

Affected Property

Joliet Chemical Fire PRP Cleanup
20604 Amherst Court
Joliet, Will County, Illinois

Figure 2
Site Layout Map

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Prepared For: USEPA	Prepared By: Tetra Tech

File Path: G:\G\G9031-START V\Illinois\Joliet Chemical Fire\mxd\Fig2 - Site Layout.mxd

Date Saved: 11/25/2019

EPA Contract No.: 68-HE-0519-D005

TO-TOLIN: 0069-0002AJ001

Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
Projection: Transverse Mercator
Datum:North American 1983 Units: Foot US

Legend

- Proposed Soil Sample Aliquot Location
- Sample Area
- Approximate Site Boundary - MPG Industries

Note: Each sample will be a composite sample composed of five aliquots

Joliet Chemical Fire PRP Cleanup
20604 Amherst Court
Joliet, Will County, Illinois

Figure 3
Proposed Soil Sampling Locations

TETRA TECH

Prepared For: USEPA | Prepared By: Tetra Tech

File Path: G:\G\G9031-START V\Illinois\Joliet Chemical Fire\mxd\Fig3 - Proposed Soil Samples.mxd

Date Saved: 11/25/2019

EPA Contract No.: 68-HE-0519-D005

TO-TOLIN: 0069-0002AJ001

Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
Projection: Transverse Mercator
Datum:North American 1983 Units: Foot US

Legend

- Proposed Soil Boring Location
- Approximate Site Boundary - MPG Industries

Joliet Chemical Fire PRP Cleanup
20604 Amherst Court
Joliet, Will County, Illinois

Figure 4
Proposed Soil Boring Locations

TETRA TECH

Prepared For: USEPA | Prepared By: Tetra Tech

File Path: G:\G\G9031-START V\Illinois\Joliet Chemical Fire\mxd\Fig4 - Proposed Soil Boring.mxd

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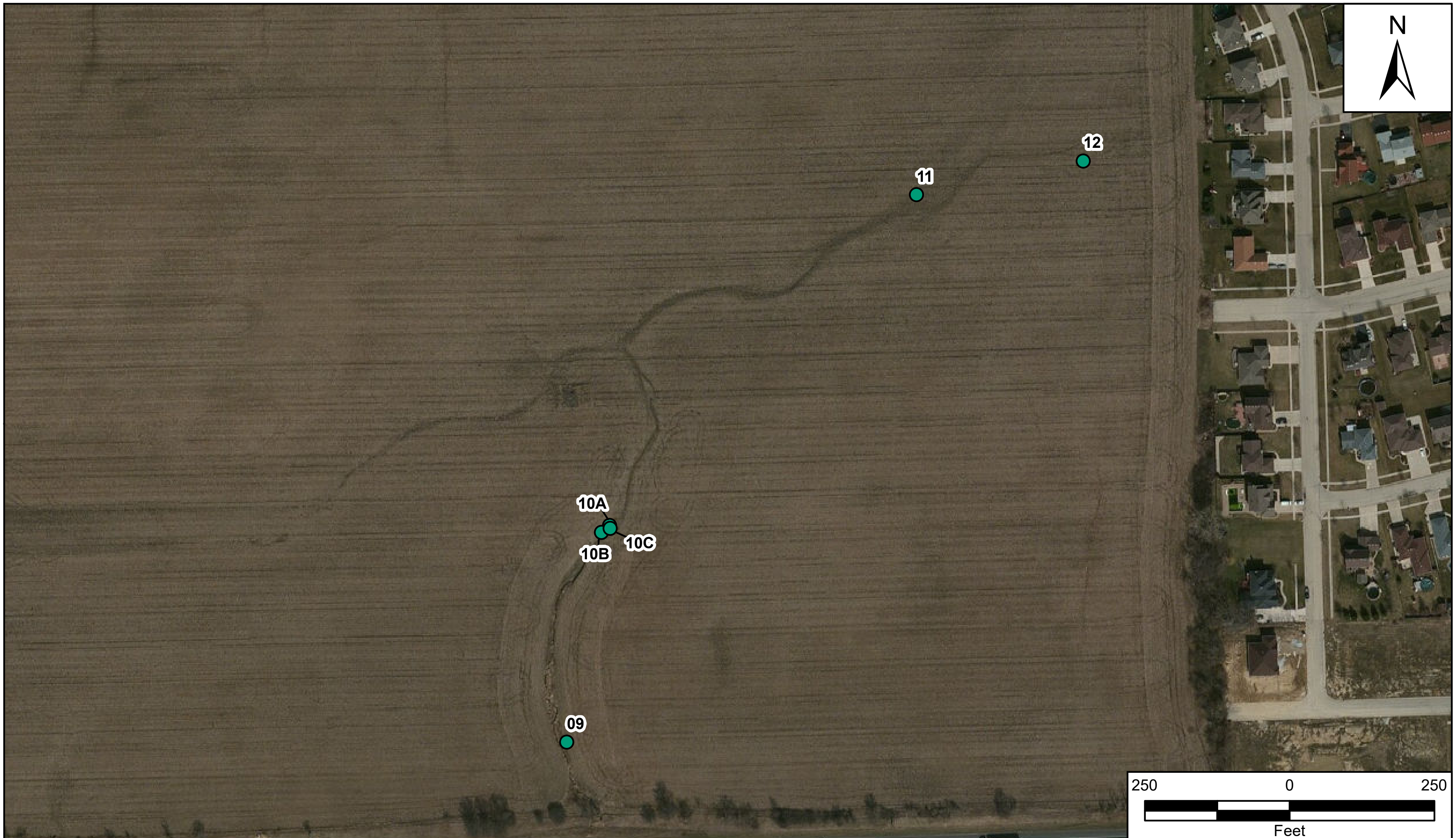

Legend

Soil Sample

Approximate Site Boundary - MPG Industries

Joliet Chemical Fire PRP Cleanup
20604 Amherst Court
Joliet, Will County, Illinois

Figure 5
Soybean Field Soil Samples

TETRA TECH

Prepared For: USEPA | Prepared By: Tetra Tech

File Path: G:\G\G9031-START V\Illinois\Joliet Chemical Fire\mxd\Fig5 - Affected Property Sample Locations.mxd

Date Saved: 11/26/2019

EPA Contract No.: 68-HE-0519-D005

TO-TOLIN: 0069-0002AJ001

Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
Projection: Transverse Mercator
Datum:North American 1983 Units: Foot US

APPENDIX B

Tables

TABLE 8: SOIL SAMPLE SUMMARY

Analytical Parameter	Analytical Method	Number of Soil Samples	Number of Field Duplicates	Number of MS/MSDs	Number of Blanks (Field, Equipment, or Rinsate)	Total Number of Samples to Laboratory[1]
TPH-DRO	SW860 8015	5	1	1	1	7
TPH	SW860 8015	18	2	1	1	21
SVOC	SW846 8270	18	2	1	1	21
VOC	SW846 8260	18	2	1	1	21

Notes:
[1] = Total number of samples to the laboratory does not include MS/MSD samples.
DRO = Diesel range organics
MS/MSD = Matrix spike/matrix spike duplicate
TPH = Total petroleum hydrocarbon
SVOC = Semi-volatile organic compound
VOC = Volatile organic compounds

TABLE 9: WATER SAMPLE SUMMARY

Analytical Parameter	Analytical Method	Number of Water Samples[1]	Number of Field Duplicates	Number of MS/MSDs	Number of Trip Blanks	Total Number of Samples to Laboratory[2]
SVOC	SW846 8270	23	3	2	1	27
VOC	SW846 8260	23	3	2	1	27

Notes:
[1] = Assumes 1 sample will be collected from 23 potable wells.
[2] = Total number of samples to the laboratory does not include MS/MSD samples.
MS/MSD = Matrix spike/matrix spike duplicate
SVOC = Semi-volatile organic compound
VOC = Volatile organic compound

TABLE 10: ANALYTICAL METHODS

Matrix	Parameter	Analytical Method	Volumes and Containers	Preservation	Holding Time[1]
Soil	TPH-DRO	SW860 8015	One 4-oz amber glass jar	Cool to 4 °C ± 2 °C immediately after collection	14 days before extraction, 40 days after extraction
Soil	TPH	SW860 8015	One 4-oz amber glass jar	Cool to 4 °C ± 2 °C immediately after collection	14 days before extraction, 40 days after extraction
Soil	SVOC	SW846 8270	One 4-oz amber glass jar	Cool to 4 °C ± 2 °C immediately after collection	14 days before extraction, 40 days after extraction
Soil	VOC	SW846 8260	One 4-oz amber glass jar or one Terra Core Kit	Cool to 4 °C ± 2 °C immediately after collection	7 days/14 days
Groundwater	SVOC	SW846 8270	One 1-L amber glass jar	Cool to 4 °C ± 2 °C immediately after collection;	7 days
Groundwater	VOC	SW846 8260	Three 40-mL glass vials	Hydrochloric acid to pH < 2; Cool to 4 °C ± 2 °C immediately after collection;	14 days

Notes:

1 Holding time is measured from the time of sample collection to the time of sample extraction and analysis.
C Celsius
DRO Diesel range organics
L Liter
mL Milliliter
TPH Total petroleum hydrocarbon
SVOC Semi-volatile organic compound
VOC Volatile organic compound

APPENDIX C

Tetra Tech Standard Operating Procedures

1. SOP 002-4 (General Decontamination)
2. SOP 005-3 (Soil Sampling)
3. SOP 019-7 (Packaging and Shipping Samples)
4. SOP 024-2 (Recording Notes in Field Logbooks)
5. SOP 061-2 (Field Measurement of Groundwater Indicator Parameters)

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

GENERAL EQUIPMENT DECONTAMINATION

SOP NO. 002

REVISION NO. 4

Last Reviewed: March 2018

Carla Buriks
Quality Assurance Approved

March 9, 2018
Date

1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. All sampling equipment must be thoroughly cleaned before each use to prevent contamination of samples.

1.3 DEFINITIONS

Alconox: Phosphate-containing soap, obtained in powder form and dissolved in water

Liquinox: Phosphate-free soap, obtained in liquid form for mixing with water

1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1992a. "Guide to Management of Investigation-Derived Wastes." Office of Solid Waste and Emergency Response. Washington, DC. EPA 9345.3-03FS. January.

EPA. 1992b. "RCRA Ground-Water Monitoring: Draft Technical Guidance." Office of Solid Waste. Washington, DC. EPA/530-R-93-001. November.

EPA. 2015. "Field Equipment Cleaning and Decontamination." Science and Ecosystem Support Division SESDPROC-205-R3 (Rev. 3, 12/18/15). https://www.epa.gov/quality/field-equipment-cleaning-and-decontamination

1.5 REQUIREMENTS AND RESOURCES

The equipment and supplies to conduct decontamination may include the following:

- Scrub brushes
- Large wash tubs or buckets
- Squirt bottles
- Alconox or Liquinox (Note: Alconox contains phosphates, and phosphates have been banned in many household cleaning products based on their adverse effect on the environment.)
- Tap water
- Distilled water
- Deionized water
- Plastic sheeting
- Aluminum foil
- Isopropanol (laboratory grade)

2.0 PROCEDURE

The procedures below discuss decontamination of personal protective equipment (PPE) as well as equipment for drilling and monitoring well installation, borehole soil sampling, general sampling, water level measurement, and groundwater sampling. PPE as outlined in the site-specific health and safety plan should be used during decontamination procedures. Special handling of used PPE and wastewater generated from decontamination procedures may be required if the type of contamination is considered hazardous according to the Resource Conservation and Recovery Act (RCRA). Any special handling should also be outlined in the site-specific health and safety plan or the sampling and analysis plan.

Some clients may have additional requirements for decontamination procedures. For example, phosphate-free detergent may be a requirement and, therefore, it would not be appropriate to use Alconox.

Source water for decontamination should be selected based on site-specific conditions and contaminants. Organic-free water would be more appropriate to use at sites where organic compounds are being investigated; conversely, laboratory-grade deionized water would be more appropriate where low levels of contaminants are being investigated. Standard distilled water, readily available at grocery stores, may be appropriate at other times. Refer to the site-specific sampling and analysis plan for details concerning source water.

In general, conduct field activities to move from cleaner to more contaminated locations to minimize the potential for cross contamination between locations.

2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off site or to clean areas. Refer to the site-specific health and safety plan as the first resource for types of PPE; not all types of PPE nor methods for decontamination discussed below will be appropriate for every site. All used disposable protective clothing, such as Tyvek, coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums (refer to Section 3.0).

Personnel decontamination procedures will be as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.

2. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.

3. Remove outer gloves and place into plastic bag for disposal.

4. Remove Tyvek or coveralls. Containerize Tyvek for disposal and place coveralls in plastic bag for reuse.

5. Remove air purifying respirator (APR), if used, and place the spent filters in a plastic bag for disposal. Filters should be changed daily or sooner, depending on use and application. Place the respirator into a separate plastic bag after it has been cleaned and disinfected according to the instructions for the respirator.

6. Remove disposable gloves and place them in plastic bag for disposal.

7. Thoroughly wash hands and face in clean water and soap.

2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION

All drilling equipment should be decontaminated at a designated location on site before drilling operations begin, between borings, and at completion of the project. Decontamination may be conducted on a temporary decontamination pad constructed at a satellite location within the site. The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Decontamination pads may be constructed of concrete, wood, or plastic sheeting, depending on the site-specific needs and plans. Wash waters and contaminated soil generated during decontamination should be considered investigation-derived waste (IDW) and, thus, should be collected and containerized for proper disposal.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they may be steam cleaned and placed on polyethylene sheeting on site before they are used downhole, if required by the site-specific work plan. The drilling subcontractor will typically furnish the steam cleaner and water.

The drilling auger, bits, drill pipe, any portion of drill rig that is over the borehole, temporary casing, surface casing, and other equipment used in or near the borehole should be decontaminated by the drilling subcontractor as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove loose soil using shovels, scrapers, wire brushes, and any related material.
3. Steam clean or pressure wash to remove all visible dirt. Use appropriate PPE (for example, a face shield and Tyvek/coveralls) as necessary.
4. If equipment has directly or indirectly contacted contaminated media and is known or suspected of being contaminated with oil, grease, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol.
5. To the extent possible, allow components to air dry; drying helps limit the spread of contamination through contact.
6. All wastewater from decontamination procedures should be containerized.

2.3 BOREHOLE SOIL SAMPLING DOWNHOLE EQUIPMENT DECONTAMINATION AND GENERAL SOIL SAMPLING EQUIPMENT DECONTAMINATION

All soil sampling equipment should be decontaminated before use and after each sample as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.

2. Scrub the split-barrel sampler and sampling tools in a wash bucket or tub using a stiff, long-bristle brush with a solution of tap water with Liquinox or Alconox.

3. Rinse equipment thoroughly with tap water or distilled water.

4. Perform a final rinse with deionized or distilled water. Refer to the site-specific sampling and analysis plan for requirements for deionized or distilled water.

5. Place cleaned equipment in a clean area on plastic sheeting or aluminum foil and allow to air-dry.

6. Containerize all water and rinsate; disposable single-use sampling equipment should also be containerized.

2.4 WATER LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures should be used:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.

2. Wipe the tape and probe with a disposable Alconox- or Liquinox-impregnated cloth or paper towel.

3. If immiscible layers are encountered, the interface probe may require steam cleaning or washing with laboratory-grade isopropanol.

4. Rinse with distilled or deionized water.

5. Containerize all water and rinsate for proper disposal.

2.5 GROUNDWATER SAMPLING EQUIPMENT

The following procedures are to be employed to decontaminate equipment used for groundwater sampling. Decontamination is not necessary when using disposable (single-use) pump tubing or bailers. Bailer and downhole pumps decontamination procedures are described in the following sections.

2.5.1 Bailers

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove and containerize any purge water remaining in the bailer.
3. Scrub the inside and outside of the bailer in a wash bucket or tub using a stiff, long-bristle brush with a solution of tap water with Liquinox or Alconox. Select cleaning equipment that will not scratch or damage the bailer.
4. Rinse the bailer thoroughly with tap water or distilled water.
5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol.
6. Perform a final rinse with deionized or distilled water.
7. Allow the cleaned bailer to air dry.
8. Wrap the bailer in aluminum foil or a clean plastic bag for storage.
9. Containerize the decontamination wash waters for proper disposal.

2.5.2 Downhole Pumps

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove and containerize any purge water in the pump and tubing and dispose of tubing.
3. Dismantle the pump as much as possible and scrub components in a wash bucket or tub using a stiff brushes of appropriate size with a solution of tap water with Liquinox or Alconox.
4. Rinse pump components thoroughly with tap water or distilled water.

5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-to-remove organic materials, rinse the pump and tubing with laboratory-grade isopropanol.
6. Perform a final rinse with deionized or distilled water.
7. Allow components to air dry.
8. Wrap pump in aluminum foil or a clean plastic bag for storage.
9. Containerize the used tubing and decontamination wash waters for proper disposal.

3.0 INVESTIGATION-DERIVED WASTE

IDW can include disposable single-use PPE and sampling equipment, soil cuttings, and decontamination wash waters and sediments. Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage will be provided in project-specific documents, or separate direction will be provided by the project manager. The following guidelines are provided for general use:

1. Assume that all IDW generated from decontamination contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
2. Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.
3. Label IDW storage containers with the facility name and address, date, contents, company generating the waste, and an emergency contact name and phone number.
4. Temporarily store the IDW in a protected area that provides access to the containers and allows for spill/leak monitoring, sampling of containers, and removal after the disposal method has been identified.

SOP APPROVAL FORM

TETRA TECH, INC.
EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

SOP NO. 005

REVISION NO. 3

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Date

1.0 BACKGROUND

Soil is sampled for three main reasons: (1) for chemical analysis in the laboratory, (2) for physical analysis in the laboratory, or (3) for evaluation in the field (for example, visual classification, assessment of staining, and field screening). These three sampling objectives can be achieved separately or in combination. Sampling locations are typically chosen to provide information in both the horizontal and vertical directions. A sampling and analysis plan or a site-specific quality assurance project plan (QAPP) is used to outline sampling methods and to provide a preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening or sampling methods used and the physical features of the area.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for soil sampling. Soil is sampled to evaluate the chemical and physical characteristics of surface and subsurface soils.

1.2 SCOPE

This SOP describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling and describes a variety of soil sampling devices.

1.3 DEFINITIONS

Bucket Auger: A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

Composite Sample: A sample that consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag.

Core Sampler: A thin-walled cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a "T" handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

Direct-push technology (DPT): Investigation tools that drive or push small-diameter rods and tools (typically not exceeding 4 inches in diameter) into the subsurface by hydraulic or percussive methods. Geoprobe Systems is a manufacturer of DPT equipment, and its brand name is often used interchangeably with "DPT."

EnCore Sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore samplers are used to collect soil samples with zero headspace, as required for volatile organic compound (VOC) analysis (including purgeable total petroleum hydrocarbons). Each sample is collected using a reusable "T" handle.

Grab Sample: A sample collected from a discrete location or depth.

Hand Auger: An instrument attached to the bottom of a length of pipe that has a crossarm or "T" handle at the top. The auger can be closed-spiral or open-spiral.

Spatulas or Spoons: Stainless steel or disposable instruments for collecting loose unconsolidated material.

Split-Spoon (or Split-Barrel) Sampler: A thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Terra Core Sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 10 grams and is part of a sampling kit. It is a single-use sampler used to collect soil samples with zero headspace, as required for VOCs. Each sample is collected with the disposable coring device. However, unlike the EnCore sampler, the sample is placed directly into a 40-milliliter (mL) glass volatile organics analysis (VOA) vial after the soil is collected. The VOA vial is included in the sampling kit.

Thin-Wall Tube Sampler: A steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

Trier: A tube cut in half lengthwise with a sharpened tip that allows for collecting sticky solids or loosening cohesive soils.

Trowel: A metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

VOA Plunger: A disposable, plastic, single-use soil device to collect samples for analysis of VOCs.

1.4 REFERENCES

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1.5 REQUIREMENTS AND RESOURCES

Soil sampling requires the use of one or more of the following types of equipment:

- Spoon and spatula
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore sampler

- Terra Core sampler
- VOA plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment may also be needed for various methods:

- Sample containers, labels, and chain-of-custody forms
- Logbook and field forms
- Stakes or flags for marking sample locations
- Tape for measuring recovery
- Soil classification information
- Wax or caps for sealing ends of thin-wall tube
- “T” Handles
- Stainless steel or Teflon bowls, aluminum pans, or other vessels for composite sampling (made from material that will not interfere with the planned analyses)
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

2.0 SOIL SAMPLING PROCEDURES

This SOP presents procedures for collecting test pit, surface soil, and subsurface soil samples. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in order of decreasing volatility, typically in the following order: (1) volatile organics, (2) semivolatile organics, and (3) metals. Samples for physical analysis can be containerized after the chemical samples have been containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the

Unified Soil Classification System (USCS, ASTM D2488-09a), should be recorded. Field tests such as head-space analysis can also be conducted using a photoionization detector or a flame ionization detector before samples are collected for chemical or physical analysis.

Soil samples for chemical analysis can be collected either as grab samples or as composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag. Refer to the site-specific QAPP for the methodology for composite sample collection. Samples for VOC analysis should not be composited.

All non-disposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002, General Equipment Decontamination.

2.1 SOIL SAMPLE COLLECTION PROCEDURES

Soil samples can be collected as discrete samples for VOC analysis using specialized equipment for preservation in the laboratory or in the field. Samples for VOC analysis should not be composited. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC Analysis

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative results based on loss of VOCs. Samples can be preserved with methanol or sodium bisulfite to reduce volatilization and biodegradation to minimize loss of VOCs. However, these preservatives are not compatible with all VOCs; refer to the unique requirements in the project-specific QAPP or work plan. Preservatives may be added to containers by the laboratory before samples are collected, or preservatives may be added in the field. Alternatively, samples may be collected directly using devices like the EnCore sampler, which minimizes soil contact with the atmosphere. The specific sampling methodology will be identified in the project-specific QAPP or work plan. Be aware that other methods of sample preservation (such as freezing) are available (EPA 2014), but are not detailed in this SOP.

Soil samples to be preserved in the laboratory are collected using SW-846 Method 5035A (EPA 2002). For samples preserved in the field, laboratories may perform low-level analysis (sodium bisulfate preservation) or high- to medium-level analysis (methanol preservation), depending on the project-specific QAPP.

The following procedures outline the steps necessary for collecting soil samples to be preserved at the laboratory and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

2.1.1.1 Soil Samples to be Preserved at the Laboratory

EnCore Sampler

Soil samples collected for VOC analysis that are to be preserved at the laboratory may be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore sampler. Each sample is collected using a reusable sampling handle ("T" handle) that can be provided with the EnCore sampler when it is requested and purchased. Collect the soil sample in the following manner for each EnCore sampler.

The EnCore sampler is loaded into the "T" handle with the plunger fully depressed. Press the "T" handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil. When the sampler is full, rotate the plunger and lock it into place using the "T" handle. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or soil may be forced against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated. Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler. Remove any surface soil from outside of the sampler and place the sampler in the foil bag provided with the sampler. Seal the bag and label it with sample location information. Typically, collect three EnCore samplers per sample location. Decontaminate the "T" handle between sample locations.

Using the EnCore sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore sampler.

After the EnCore samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours after they are collected.

Terra Core Sampler

New sampling collection equipment such as Terra Core have been developed to compete with EnCore when samples are collected for VOC analysis. Depending on the laboratory conducting the analysis, one of these two common VOC sampling devices may be used. In the case that Terra Core samplers are provided, collect the soil sample in the following manner.

Each Terra Core sampling kit comes with one Terra Core sampler that collects either a 5- or a 10-gram aliquot into multiple containers: one methanol-preserved 40 mL VOA vial for high-level analysis, two 40-mL VOA vials containing stir bars for undiluted/low-level analysis, and one 60-gram sample jar for percent moisture analysis. To collect a sample, with the plunger seated in the handle, push the sampler into freshly exposed soil until the sample chamber is filled. Wipe any excess soil and debris from the exterior of the sampler and remove any soil that extends beyond the mouth of the sampler. Then, rotate the plunger that was seated in the handler top 90 degrees until it aligns with the slots in the body. Place the mouth of the sampler into the desired 40 mL VOA vial and extrude the sample by pushing the plunger down. Quickly place the lid back on the VOA vial. After all vials provided have been filled, the sampler is now contaminated and must be disposed of unless additional, bulk sampling will be conducted.

After the Terra Core samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours after they are collected. Because the vials are pre-weighed, no additional labels should be added. Sampling information should be written directly on the label already on the vial.

2.1.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analysis using both the low-level (sodium bisulfate preservation) and the high- to medium-level (methanol preservation) methods. If samples effervesce when they are placed in preservative, it is necessary to collect a sample unpreserved, in deionized water. In addition, an unpreserved sample for determination of moisture content must also be collected when soil samples to be preserved in the field are collected.

Methanol Preservation (High to Medium Level). Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Use 40- to 60-mL glass vials with septum-lined lids for soil samples to be preserved in the field with methanol. Fill each sample bottle with 25 mL of demonstrated analyte-free purge-and-trap grade 3 methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

Use a decontaminated (or disposable), small-diameter coring device such as a disposable VOA plunger to collect the soil. The outside diameter of the coring device must be smaller than the inside of the sample bottle neck. To collect the sample, pull the plunger back to the required location, insert it into the soil to be sampled, push the coring device into the soil, extrude the soil sample into the methanol-preserved sample bottle, and cap the bottle tightly. Swirl the sample (do not shake) in the methanol to break up the soil such that all of the soil is covered with methanol. After the samples are collected, place them on ice immediately and deliver to the laboratory within 48 hours.

Sodium Bisulfate Preservation (Low Level). Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be preserved in the field using sodium bisulfate are collected using the same procedures described for methanol preservation.

2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analysis

Samples collected for non-VOC analysis may be either grab or composite samples as follows. When collecting a grab sample, transfer a portion of soil to be analyzed to a stainless-steel or Teflon bowl, disposable inert plastic tray, or plastic bag. Avoid or remove vegetation and small stones. When a composite sample is collected, collect four to five discrete soil samples of roughly equal volume, based on the sample design in the QAPP. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel (about ¼- to ½-inch diameter). Thoroughly mix the soil with a stainless-steel spoon to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close the containers. Label the sample containers and immediately place on ice.

2.2 TEST PIT AND TRENCH SOIL SAMPLING

Test pit and trench soil samples are collected when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. The sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles before any test pit or trench is excavated with a backhoe.

A test pit or trench is excavated by incrementally removing soil with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel may enter any test pit or trench excavation more than 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 of the *Code of Federal Regulations* § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before they may enter the test pit, and use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific health and safety plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel may direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe operator will set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator must disengage the controls and signal to the sampler that it is safe to approach the bucket. Collect the soil sample from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore sampler, Terra Core sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

2.3 SURFACE SOIL SAMPLING

Surface soil samples can be used to investigate contaminants that exist in the near-surface environment. Contaminants detected in the near-surface environment may extend to considerable depths, potentially migrating to groundwater, surface water, the atmosphere, or biological systems. Sampling depths for surface soil are typically those that can be reached without use of a drill rig, DPT, or other mechanized equipment. Sample depths typically extend up to 1 foot below ground surface (bgs). However, the definition of "surface soil" and the resultant sample depths may vary based on risk assessment or other project requirements. Be aware of these site-specific constraints and follow the requirements of the QAPP to select the depths for surface soil samples.

2.3.1 Surface Soil Sampling Equipment

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet bgs. The sample depth, analytical suite, soil type, and soil moisture will also dictate the most suitable sampling equipment. The sampling locations should be cleared of any surface debris such as twigs, rocks, and litter before samples are collected. The following table presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

Sampling Equipment	Effective Depth Range (feet below ground surface)	Operating Means	Sample Type
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
EnCore or Terra Core Sampler	Not Applicable	Manual	Disturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed
Volatile Organic Analysis (VOA) Plunger	Not Applicable	Manual	Disturbed

The procedures for using these various types of sampling equipment are discussed below.

2.3.1.1 Hand Auger

A hand auger equipped with extensions and a "T" handle is used to obtain samples from depths of up to 6 feet bgs. It is possible to hand auger deeper than 6 feet. However, hand-augering below this depth is uncommon because of the time, effort, and cost effectiveness when sampling to depths greater than 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; establishing the exact depth where samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated the soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

2.3.1.2 Bucket Auger

A bucket auger, similar to the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when stony or dense soil is sampled that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the soil collected is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

2.3.1.3 Core Sampler

A hand-operated core sampler (Figure 1), similar to the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed or driven (for example, using a slide hammer) into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

2.3.1.4 Shovel

A shovel or spade may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless-steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

2.3.1.5 Trier

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

2.3.1.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless-steel trowel. Samples may be placed directly from the trowel into sample containers.

2.4 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling is accomplished in conjunction with borehole drilling for depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. As described above for surface soil, the definition of “subsurface soil” may vary based on risk assessment or other project requirements. Be aware of site-specific constraints and follow the requirements of the QAPP to select the depths for subsurface soil samples.

2.4.1 Subsurface Soil Sampling Equipment and Methods

Subsurface soil may be sampled using a drilling rig, power auger, or DPT. Selection of sampling equipment depends on geologic conditions and the scope of the sampling program. Two types of samplers used with machine-driven augers — the split-spoon sampler and the thin-wall tube sampler — are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP 002, General Equipment Decontamination. Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from unconsolidated soils. The procedures for DPT sampling are also presented below.

2.4.1.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, dictate the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. A catcher or basket should be used to help retain the sample in noncohesive or saturated soil.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOA samples are to be collected, EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the soil recovered can then be used for visual classification of the sample and containerized for physical analysis. The entire sample (except for the top several inches of possibly disturbed material) is retained for analysis or disposal.

2.4.1.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until it meets refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After the tube sampler is removed from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if the tube sampler can retain the sample material). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, VOA samples must be collected immediately after the tube sampler is withdrawn. EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. The tube is sealed using plastic caps for physical sampling parameters. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

2.4.1.3 Direct-Push Technology Methods

In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT drill rigs, as well as traditional drill rigs, often use acetate or clear polyvinyl chloride sleeves or brass liners inside of split-spoon or thin-wall tube samplers for collecting soil samples.

The sample sleeve is extruded from the sampling rod when the sampling rod is retrieved from the ground. The sleeve is sliced lengthwise twice to open the sleeve. Soil samples can be collected directly from the opened sleeve. EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the opened DPT sampler if VOA samples are to be collected. Samples for other specific chemical analysis should be collected after the VOA sample. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample is retained for analysis or disposal.

FIGURE 1

HAND-OPERATED CORE SAMPLER

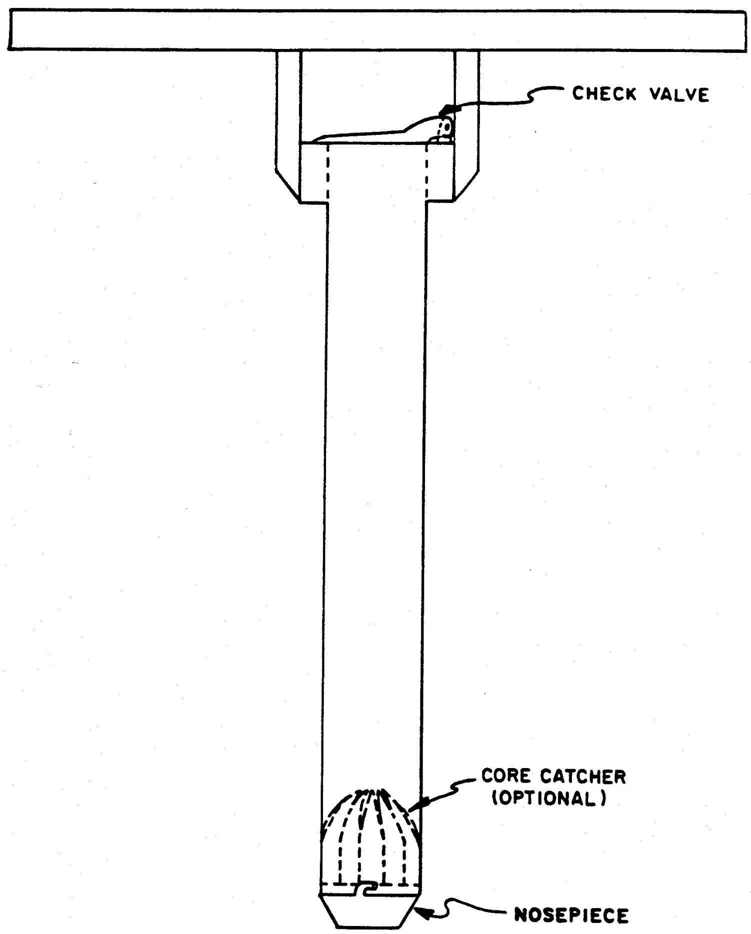


FIGURE 2

TRIER

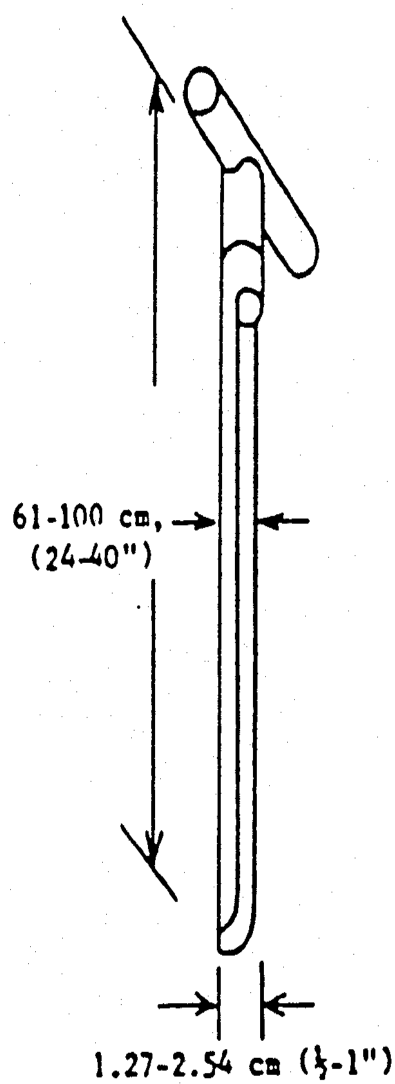


FIGURE 3

GENERIC SPLIT-SPOON SAMPLER

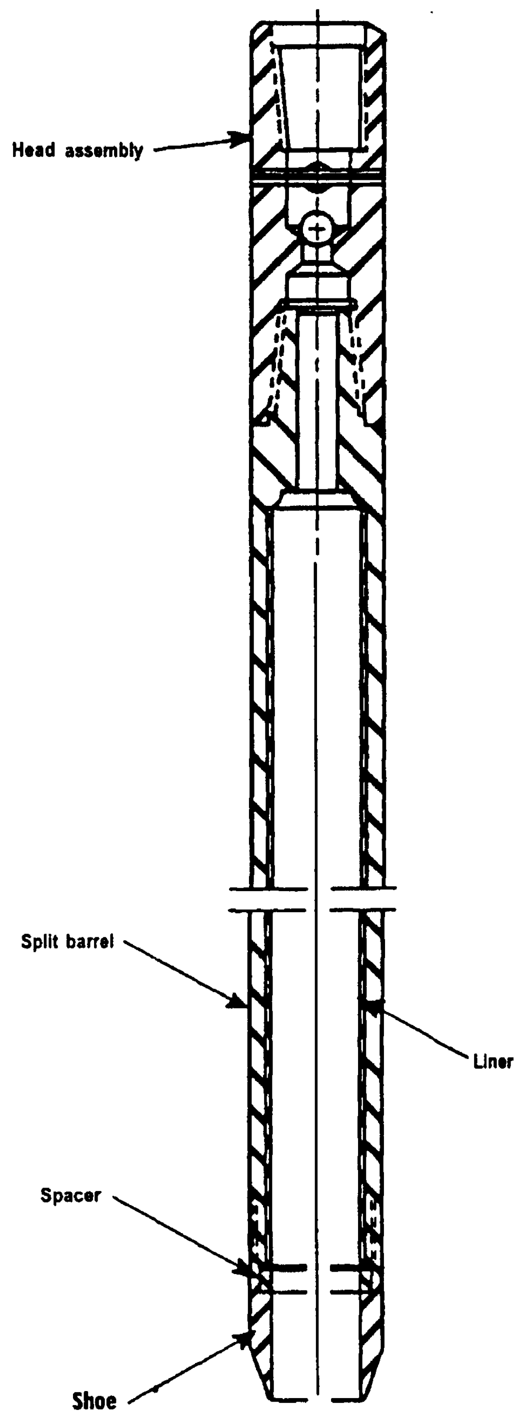
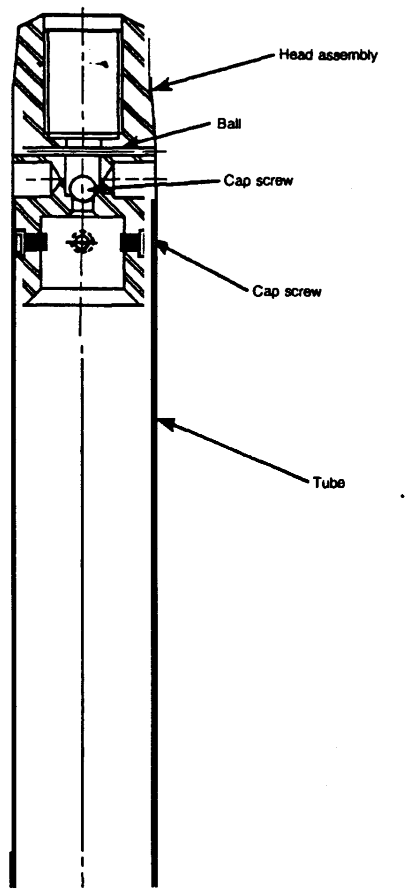


FIGURE 4

THIN-WALL TUBE SAMPLER



SOP APPROVAL FORM

TETRA TECH, INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

PACKAGING AND SHIPPING SAMPLES

SOP NO. 019

REVISION NO. 7

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Date

1.0 BACKGROUND

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. This standard operating procedure (SOP) describes procedures for packaging and shipping samples. Steps in the procedures should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples.

1.1 PURPOSE

This SOP establishes the requirements and procedures for packaging and shipping samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) "Contract Laboratory Program Guidance for Field Samplers." Procedures described in this SOP should be followed for all routine sample packaging and shipping. If procedures are to be modified for particular contract- or laboratory-specific requirements, modified procedures should be clearly described in site-specific plans such as work plans, field sampling plans (FSPs), or quality assurance project plans (QAPPs). Deviations from the procedures in this SOP must be documented in a field logbook. This SOP assumes that samples are already in the appropriate sample jars and that the sample jars are labeled.

This SOP does not cover the packaging and shipment of Dangerous Goods or Hazardous Materials. The shipment of Dangerous Goods (by air) and Hazardous Materials (by ground) requires specialized training. If you have NOT received this training in the last two years, you are NOT qualified to package or ship these materials and may be personally liable for any damages or fines. Contact one of Tetra Tech's shipping experts for assistance. Instructions to access the training course, shipping experts and health and safety (H&S) contacts, and general information on packaging and shipping hazardous substances and dangerous goods can be obtained by checking the links provided in Section 1.4 (References).

1.2 SCOPE

This SOP applies to packaging and shipping of environmental and nonhazardous samples. This SOP does not address shipping dangerous goods or hazardous materials.

1.3 DEFINITIONS

Airbill: An airbill is a shipping form (such as a FedEx shipping form) acquired from the commercial shipper and is used to document shipment of the samples from the sampler to the designated analytical laboratory (see Figure 1).

Custody-of-Custody form: A chain-of-custody form is used to document the transfer of custody of samples from the field to the designated analytical laboratory (see Figure 2). The chain-of-custody form is critical to the chain-of-custody process and is used to identify the samples in each shipping container to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis (see Figure 3).

Custody seal: A custody seal is a tape-like seal and is used to indicate that samples are intact and have not been disturbed during shipping or transport after the samples have been released from the sampler to the shipper (see Figure 4). The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packaged for shipping (see Figure 5).

Environmental samples: Environmental samples include drinking water, most groundwater and surface water, soil, sediment, treated municipal and industrial wastewater effluent, indoor and ambient air, nonhazardous bulk materials, soil gas, dust, asbestos, and biological specimens. Environmental samples typically contain low concentrations of contaminants and, when handled, require only limited precautionary procedures.

Field Blank: A field blank is any blank sample that is packaged and shipped from the field. Each field blank is assigned its own unique sample number. Field blanks include trip blanks, rinse blanks, and equipment blanks, all intended to assess potential cross-contamination. For example, a trip blank checks for contamination during sample handling, storage, and shipment from the field to the laboratory.

Nonhazardous samples: Nonhazardous samples are those samples that do not meet the definition of a hazardous sample and **do not** need to be packaged and shipped in accordance with the International Air Travel Association's (IATA's) "Dangerous Goods Regulations" (DGR) or U.S. Department of Transportation's (U.S. DOT's) "Hazardous Materials Regulations" (HMR) defined in Title 49 Code of Federal Regulations (CFR).

The following definitions are provided to further distinguish environmental and nonhazardous samples from dangerous good and hazardous samples:

Dangerous goods: Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 2014).

Hazardous samples: Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the HMR.

Hazardous substance: A hazardous substance is any material, including its mixtures and solutions, that is listed in 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity (RQ) listed in Table 1 to Appendix A of 49 CFR 172.101.

1.4 REFERENCES

General Awareness, H&S contacts, and course training information" click here. (Tetra Tech, Inc., EMI Operating Unit. Intranet) Available on-line at: https://int.tetratech.com/sites/EMI/hs/Pages/Dangerous-Goods-Shipping.aspx

International Air Transport Association (IATA). 2014. "Dangerous Goods Regulations. 2014." For sale at: http://www.iata.org/publications/Pages/standards-manuals.aspx. Updated annually, with new edition available late in year.

U.S. Environmental Protection Agency (EPA). 40 CFR, 763 Subpart F, Asbestos Hazards Emergency Response Act (AHERA).

EPA. 2011. "Contract Laboratory Program Guidance for Field Samplers." EPA 540-R-09-03. Available on-line at: http://www.epa.gov/oerrpage/superfund/programs/clp/download/sampler/CLPSamp-01-2011.pdf. January.

1.5 REQUIREMENTS AND RESOURCES

The procedures for packaging and shipping samples require the following:

- Coolers (insulated ice chest) or other shipping containers appropriate to sample type
- Ice
- Bubble wrap or similar cushioning material
- Chain-of-custody forms and seals
- Airbills
- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)
- Large plastic garbage bags for lining the cooler
- Temperature blank sample bottle filled with distilled water can be included in the cooler if appropriate to sample type

- Trip blank samples used to check for volatile contamination during sample handling in the field and shipment from field to laboratory should be included in the cooler if volatile organic compounds are requested for analysis. Also see Field Blank under definitions.

2.0 PROCEDURES

The following procedures apply to packaging and shipping nonhazardous and environmental samples.

2.1 PACKAGING SAMPLES

After they have been appropriately containerized and labeled, environmental samples should be packaged as described in this section. This section covers procedures for packing samples for delivery by commercial carrier (air or ground) and hand delivery of environmental samples (by employee or courier), as well as shipping asbestos and air quality samples. Note that these instructions are general; samplers also should be aware of client-specific requirements concerning the placement of custody seals or other packaging provisions.

2.1.1 Packaging Samples for Delivery by Commercial Carrier (Air or Ground)

Samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

Preparing the sample:

1. Allow a small amount of headspace in all bottles, or as instructed by the laboratory (except volatile organic compound [VOC] containers with a septum seal) to compensate for any changes in pressure and temperature during transfer.
2. Be sure the lids on all bottles are tight (will not leak). Lids maybe taped or sealed with custody seals as added protection or as required.
3. Place sample containers in resealable plastic bags.

Preparing the cooler:

1. Secure and tape the drain plug of the cooler with fiber or duct tape.
2. It is recommended that the cooler be lined with a large plastic garbage bag before samples, ice, and absorbent packing material are placed in the cooler.
3. Wrap the sample containers in bubble wrap or line the cooler (bottom and sides) with a cushioning material to prevent breakage of bottles or jars during shipment.
4. Add a sufficient quantity of ice to the cooler to cool samples to 4 °C ($\pm$ 2 °C). Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.

5. For volatile organic analysis (VOA) samples only, include one trip blank for VOA analysis per shipment matrix in each cooler.
6. Fill all remaining space between the bottles or jars with bubble wrap.
7. Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).
8. If more than one cooler is being shipped, mark each cooler as "1 of 2," "2 of 2," and so forth.
9. Place the chain-of-custody forms (see Figure 2) into a resealable plastic bag, and tape the bag to the inner side of the cooler lid (see Figure 3). If you are shipping more than one cooler, copy the chain-of-custody form so that there is one copy of all forms in each cooler. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler. Tape any instructions for returning the cooler to the inside of the lid.
10. Close the lid of the cooler and tape it shut by wrapping strapping tape around both ends and hinges of the cooler at least once.
11. Place two signed custody seals (see Figure 4) on opposite sides of the cooler, ensuring that each one covers the cooler lid and side of the cooler (see Figure 5; note that in contrast to the figure, the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in Figure 5). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal.
12. Shipping containers must be marked "THIS END UP." Arrow labels, which indicate the proper upward position of the container, may also be affixed to the container (see Figures 3 and 5). A label containing the name, phone number, and address of the shipper should be placed on the outside of the container (Federal Express [FedEx] label) (see Figure 1).
13. Ship samples overnight using a commercial carrier such as FedEx.

2.1.2 Hand Delivery of Environmental Samples (by Employee or Courier)

Samples hand-delivered to the laboratory should be packed for shipment using the following procedures:

Preparing the sample:

1. Bottles can be filled completely with sample (required for VOC containers with a septum seal).
2. Be sure the lids on all bottles are tight (will not leak).

Preparing the cooler:

1. Secure and tape the drain plug of the cooler with fiber or duct tape.
2. Wrap the sample containers in bubble wrap and/or line the cooler (bottom and sides).
3. Add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.
4. For VOA samples only, include one trip blank for VOA analysis per shipment matrix in each cooler.
5. If more than one cooler is being shipped, mark each cooler as "1 of 2," "2 of 2,"and so forth.

6. Place chain-of-custody form (see Figure 2) in a resealable plastic bag and tape to the inside of the cooler lid, close the lid, seal with custody seals, and transfer the cooler to the courier (see Figure 3). Alternatively, when samples will be delivered directly to the laboratory, close the cooler and hand-deliver it with the chain-of-custody form. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler.
7. Include any instructions for returning the cooler to the inside of the lid.
8. Place two signed custody seals (see Figure 4) on opposite sides of the cooler, ensuring that each one covers the cooler lid and side of the cooler (see Figure 5, note that the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in Figure 5). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal.
9. Shipping containers must be marked "THIS END UP," and arrow labels, which indicate the proper upward position of the container should be affixed to the container (see Figures 3 and 5).

2.1.3 Shipping Asbestos Samples

Asbestos samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

1.` Place each asbestos sample in a small resealable plastic bag. Place the bags of asbestos samples in a large resealable plastic bag.
2. Select a rigid shipping container (FedEx box) and pack the cassettes upright in a noncontaminating, nonfibrous medium such as a bubble pack to prevent excessive movement during shipping.
3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.
4. Affix custody seals to the top of the cassettes or outer sample bag so that the bags cannot be opened without breaking the seal.
5. Insert the chain-of-custody form in the box. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information.
6. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container will be rejected.
7. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.
8. Hand-carry samples to the laboratory in an upright position if possible; otherwise, choose that mode of transportation least likely to jar the samples in transit.
9. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain-of-custody and sample tracking procedures. This information will also help the laboratory schedule timely analysis for the samples when they are received.

2.1.4 Shipping Air Samples

Packaging and shipping requirements for air samples vary depending on the media used to collect the samples and the analyses required. Sampling media typically include Summa canisters and Tedlar bags for whole air samples, filters for metals and particulate matter, and sorbent tubes for organic contaminants. This section of the SOP provides general guidelines for packaging and shipping air samples collected using these media. The project FSP or QAPP should also be reviewed for any additional project-specific requirements or instructions.

Summa Canister Samples

1. Close the canister valve by tightening the knob clockwise or flipping the toggle switch. Replace the brass cap on the canister inlet.
2. If a flow controller was used to collect the air sample over a specified time interval, the flow controller should be removed before replacing the brass cap.
3. Fill out the sample tag on the canister with the sample number and the date and time of collection. Include the identification number of the flow controller on the sample tag if one was used. Make sure the information on the sample tag matches the chain-of-custody form.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final Summa canister vacuum readings; Summa canister identification number; and flow controller identification number.
5. Package the Summa canister (and flow controller) in its original shipping box with the original packaging material. Tape the box shut and apply custody seals if required. Note: Summa canisters should never be packaged with ice.
6. Summa canister shipments typically include several canisters, and may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes.
7. Ship the samples by a method that will meet the holding time. Summa canister samples should be analyzed within 30 days of sample collection.

Tedlar Bag Samples

1. Close the Tedlar bag by tightening the valve clockwise.
2. Fill out the label on the bag with the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Complete the chain-of-custody form.
4. Package the Tedlar bag in a shipping box with appropriate packing material. Multiple bags can be packaged in the same box. Tape the box shut and apply custody seals if required. Note: Tedlar bag samples should not be cooled or packaged with ice.
5. Tedlar bag shipments may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes.

6. Ship the samples using priority overnight delivery. Tedlar bag samples should be analyzed within 3 days of sample collection.

Filter Cassette Samples

1. Disconnect the filter cassette from the air sampling pump and replace the plastic caps on the inlet and outlet openings.
2. Attach a label to the sample that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
4. Package the filter cassettes in a shipping box (such as a FedEx box). Use an appropriate packing material (such as bubble wrap) to separate the samples and prevent damage.
5. Place the chain-of-custody form within the box, seal the box, and apply custody seals if required. Filter cassette samples typically do not need to be cooled, but check the FSP or QAPP for project-specific requirements.
6. Ship the samples by a method that will meet the holding time.

Sorbent Tube Samples

1. Disconnect the sample tube from the air sampling pump and seal both ends of the tube with plastic caps.
2. Complete a sample label that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. If the tube is small and the label cannot be attached to the tube, the tube can be placed in a small sealable plastic bag and the label can be attached to the bag or placed inside the bag with the tube.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
5. Packaging requirements for the sample tubes will depend on the analysis required, and the sampler should check the FSP or QAPP for project-specific requirements (for example, tubes may need to be wrapped in aluminum foil to prevent exposure to light). Packaging containers and methods include (1) shipping boxes (as described under filter cassette samples), (2) small sample coolers filled with double-bagged ice, and (3) small sample coolers filled with blue ice.
6. Place the chain-of-custody form within the box or container, seal the box or container, and apply a custody seal if required.
7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
8. Ship the samples by a method that will meet the holding time.

Polyurethane Foam (PUF) Tube Samples

1. Disconnect the PUF tube from the air sampling pump and wrap the tube in aluminum foil.
2. Attach a label to the wrapped sample tube that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Wrap the PUF tube in bubble wrap and place the tube in a glass shipping jar.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
5. Package the PUF tube jars in a cooler that is filled with double-bagged ice. Use bubble wrap or other cushioning material to separate the samples and prevent breakage.
6. Place the chain-of-custody form within the cooler, seal the cooler, and apply a custody seal if required.
7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
8. Ship the samples by a method that will meet the holding time. Samples collected in PUF tubes typically must be extracted within 7 days of collection.

2.2 SHIPPING DOCUMENTATION FOR SAMPLES

Airbills, chain-of-custody forms, and custody seals must be completed for each shipment of nonhazardous environmental samples. Figures 1, 2, and 4 provide examples of these forms and instructions for completing them.

Field staff collecting samples should also review their field work plans to confirm what documentation must be completed during each sampling event, including client-specific requirements. For example, some EPA programs have a specific requirement to use Scribe software, an environmental data management system, to create sample documentation, electronically input information into Traffic Report or chain-of-custody forms, and enter other data.

- The Scribe software can be accessed from the EPA Environmental Response Team (ERT) at the following address: http://www.ertsupport.org/scribe_home.htm
- The ERT User Manual for Scribe, reference, and training materials can be accessed from the Scribe Support Web site at the following address: http://www.epaosc.org/scribe

Note that some laboratories must routinely return sample shipping coolers within 14 calendar days after the shipment has been received. Therefore, the sampler should also include instructions for returning the cooler with each shipment, when possible. The sampler (not the laboratory) is responsible for paying for return of the cooler and should include shipping airbills bearing the sampler's shipping account number, as well as a return address to allow for return of the cooler (see Figure 1). Samplers should use the least expensive option possible for returning coolers.

2.3 SHIPMENT DELIVERY AND NOTIFICATION

A member of the field sampling team must contact the laboratory to confirm it accepts deliveries on any given day, especially Saturdays. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required. The sampler needs to know the laboratory's contact name, address, and telephone number and be aware of the laboratory's requirements for receiving samples.

The sampler needs to know the shipping company's name, address, and telephone number (see Figure 1). In addition, samplers should be aware of the sample holding times, shipping company's hours of operation, shipping schedule, and pick-up and drop-off requirements to avoid delays in analytical testing.

Priority Overnight Delivery

Priority overnight delivery is typically the best method for shipment. Delays caused by longer shipment times may cause the sample temperature to rise above the acceptable range of 4° C (± 2 ° C) and technical holding may expire, which in turn may compromise sample integrity and require recollection of samples for analysis. If sample delivery procedures are to be modified for particular contract- or laboratory-specific requirements, the procedures should be clearly described in site-specific plans such as work plans, FSPs, or QAPPs.

Saturday Delivery

If planning to ship samples for Saturday delivery, the laboratory must be contacted in advance to confirm it will accept deliveries on Saturdays or arrange for them to be accepted. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required.

2.4 HEALTH AND SAFETY CONSIDERATIONS

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHA) for the project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment (PPE) necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, project-specific Health and Safety Plan (HASP).

3.0 POTENTIAL PROBLEMS

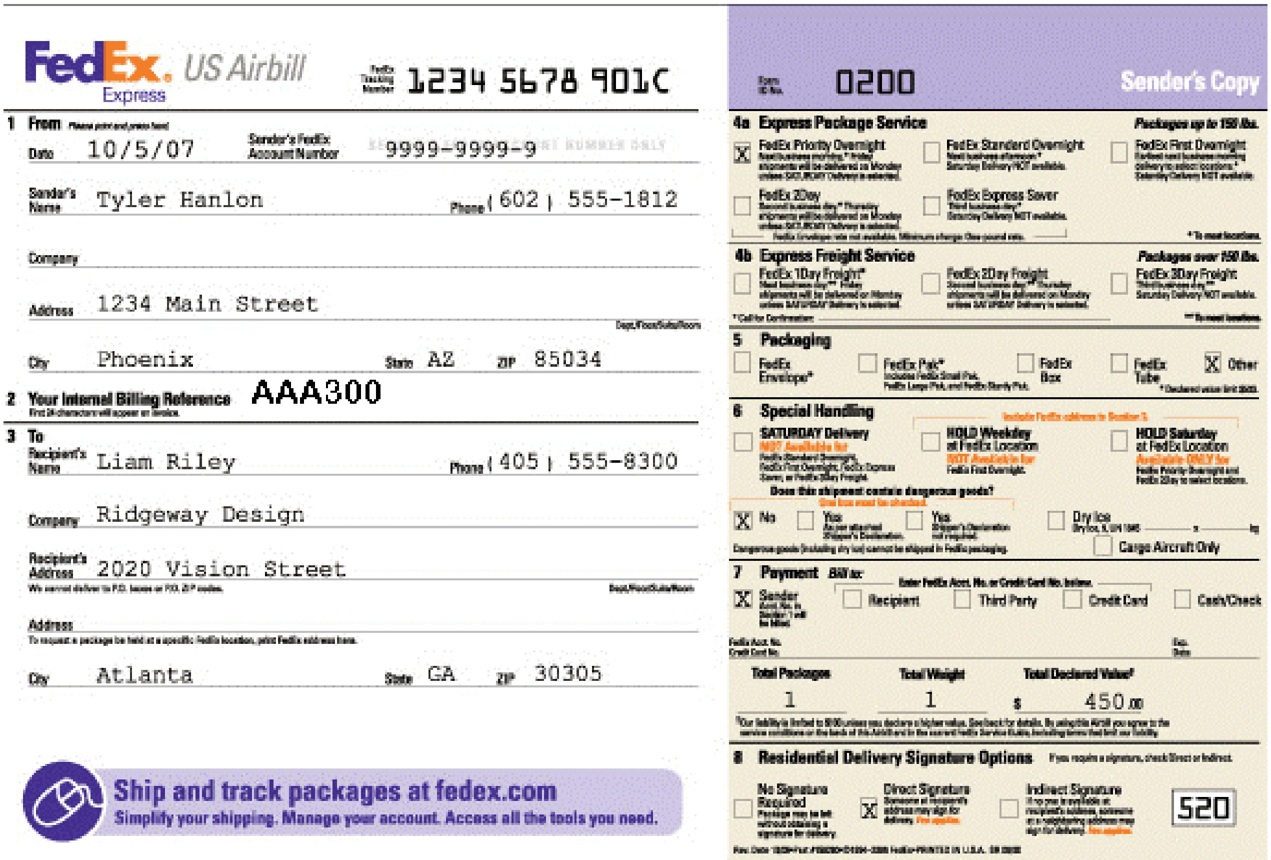
The following potential problems may occur during sample shipment:

- Leaking package. If a package leaks, the carrier may open the package and return the package. Special care should be taken during sample packaging to minimize potential leaks.
- Improper labeling and marking of package. If mistakes are made in labeling and marking the package, the carrier will most likely notice the mistakes and return the package to the shipper, thus delaying sample shipment. A good practice is to have labels, forms, and container markings double checked by a member of the field team.
- Bulk samples and air samples delivered to the analytical laboratory in the same container. If samples are combined in this way, they will be rejected. Always ship bulk samples in separate containers from air samples.
- Issues in packing asbestos samples. When asbestos samples are shipped, avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials with asbestos samples because of possible contamination.
- Improper, misspelled, or missing information on the shipper's declaration. The carrier will most likely notice these errors as well and return the package to the shipper. A good practice is to have another field tram member double check this information.
- Missed drop off time or wrong location. Missing the drop off time or having the wrong location identified for drop off will delay delivery to the laboratory and may cause technical holding times to expire. Establish the time requirements in advance of completing the field effort and be sure and provide some contingency time for potential delays such as traffic or checking and redoing paperwork.
- Incorrectly packaging samples for analysis at multiple laboratories. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory. All field staff should be aware which samples are to be shipped to which laboratory they package samples for multiple types of analysis.
- Holidays or weather-related delays. Be aware of holidays and weather forecasts that could cause delays in delivery. Delays caused by longer shipping times may cause technical holding times to expire, which in turn may compromise sample integrity or require recollection of samples for analysis.
- Not noting field variances in field log book. Field variances should be noted in the field log book and the project manager notified. Common field variances include:
  - Less sample volume collected than planned. Notify appropriate staff and the laboratory to ensure there is an adequate amount for analysis.

- Sample collected into incorrect jar because of broken or missing bottle-ware. Notify appropriate laboratory staff to ensure there is no confusion regarding the analysis of the sample.

FIGURE 1

EXAMPLE OF A FEDEX US AIRBILL FOR LOW LEVEL ENVIRONMENTAL SAMPLES


FedEx Express US Airbill
FedEx Tracking Number 1234 5678 901C
Form I.D. No. 0200
Sender's Copy

1 From
Date 10/5/07
Sender's FedEx Account Number 9999-9999-9
Sender's Name Tyler Hanlon
Phone (602) 555-1812
Company
Address 1234 Main Street
Dept./Floor/Suite/Room
City Phoenix State AZ ZIP 85034

2 Your Internal Billing Reference AAA300

3 To
Recipient's Name Liam Riley
Phone (405) 555-8300
Company Ridgeway Design
Recipient's Address 2020 Vision Street
Dept./Floor/Suite/Room
Address
City Atlanta State GA ZIP 30305

Ship and track packages at fedex.com
Simplify your shipping. Manage your account. Access all the tools you need.

4a Express Package Service — Packages up to 150 lbs.
[X] FedEx Priority Overnight
[ ] FedEx Standard Overnight
[ ] FedEx First Overnight
[ ] FedEx 2Day
[ ] FedEx Express Saver

4b Express Freight Service — Packages over 150 lbs.
[ ] FedEx 1Day Freight
[ ] FedEx 2Day Freight
[ ] FedEx 3Day Freight

5 Packaging
[ ] FedEx Envelope
[ ] FedEx Pak
[ ] FedEx Box
[ ] FedEx Tube
[X] Other

6 Special Handling
[ ] SATURDAY Delivery
[ ] HOLD Weekday at FedEx Location
[ ] HOLD Saturday at FedEx Location
Does this shipment contain dangerous goods?
[X] No
[ ] Yes As per attached Shipper's Declaration
[ ] Yes Shipper's Declaration not required
[ ] Dry Ice
[ ] Cargo Aircraft Only

7 Payment Bill to:
[X] Sender
[ ] Recipient
[ ] Third Party
[ ] Credit Card
[ ] Cash/Check
Total Packages 1
Total Weight 1
Total Declared Value $ 450.00

8 Residential Delivery Signature Options
[ ] No Signature Required
[X] Direct Signature
[ ] Indirect Signature
520

Filling Out the FedEx US Airbill

- The sender *must complete* the following fields on the pre-printed airbill:
  - Section 1: Date
  - Section 1: Sender's FedEx Account Number
  - Section 1: Sender's Name, Company, Address, and Phone Number
  - Section 2: Internal Billing Reference (Project Number)
  - Section 3: Recipient's Name, Company, Address, and Phone Number
  - Section 4: Express Package or Freight Services (Priority Overnight)
  - Section 5: Packaging (usually "Other," your own packaging)
  - Section 6: Special Handling (Saturday delivery if prearranged with receiving laboratory; "No" dangerous goods contained in shipment)
  - Section 7: Payment ("Bill to Sender")
  - Section 7: Total Number of Packages
  - Section 7: Total Weight (completed by FedEx employee)
  - Section 8: Delivery Signature Options ("No Signature Required")

FIGURE 2

EXAMPLE OF A CHAIN-OF-CUSTODY FORM (WHITE COPY)

Tetra Tech EM Inc.
Oakland Office
1999 Harrison Street, Suite 500
Oakland, CA 94612
510.302.6300 Phone
510.433.0830 Fax

Chain of Custody Record No. 9814 13G175 Page 1 of 1

Project name: Concord PARNI	Lab PO#: 13OAK27	Lab: EMAX
Project (CTO) number: 1036R59029	TtEMI technical contact: Sara Woolley	Field samplers: Sandy Jack, Rebecca Johnson
	TtEMI project manager: Steve Dellhomme	Field samplers' signatures:

No./Container Types; Preservative Added; Analysis Required

	Sample ID	Point ID/Depth	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar 8oz	250 ml Poly	Encore	VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB
Preservative Added															NONE		NONE		NONE	
1	029SRESS01		7/22/13	1240	Soil						2				X		X		X	X
2	029SRESS02		7/22/13	1245							2				X		X		X	X
3	029C3DSS01		7/24/13	1200							1				X		X		X	
4	029C3DSS02			1215							1				X		X		X	
5	029C3DSS03			1230							1				X		X		X	
6	029C3DSS04			1245							1				X		X		X	

	Name (print)	Company Name	Date	Time
Relinquished by:	Rebecca Johnson	TtEcoTt	7/30/13	1630
Received by:	Cecilia Chavez	EMAX	7/30/13	09:30
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

1002

Turnaround time/remarks: Standard TAT Temp – 2.0°C
Prioritize: SVOCs, TPH-e on 029C3DSS01 → 04 then metals

Fed Ex #: 8612 4667 7215

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

Completing a Sample Chain-of-Custody Form

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody and Request for Analysis (CC/RA) Form (Figure 1, Chain of Custody Record) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the triplicate, carbonless form will include:

1. Project identification (ID) (for example, contract and task order number);
2. Project Contract Task Order (CTO) number;
3. Laboratory Project Order (PO) number;
4. Tetra Tech Technical Contact;
5. Tetra Tech Project Manager
6. Laboratory name;
7. Field sampler names;
8. Field sampler signature;
9. Sample ID;
10. Point ID and Depth (Do **NOT** include this information on the laboratory copy of the chain-of-custody (top white copy);
11. Date and time of sampling;
12. Sample matrix type;
13. Sample preservation method; note "NONE" if no preservatives;
14. Number and types of sample containers and container capacity;
15. Sample hazards (if any);
16. Requested analysis;
17. Requested sample turnaround time or any special remarks;
18. Page __ of __;
19. Method of shipment;
20. Carrier/waybill number (if any);
21. Signature, name, and company of the person relinquishing the samples and the person receiving the samples when custody is transferred;
22. Date and time of sample custody transfer;

23. Condition of samples when they are received by the laboratory.

The sample collector will cross out any blank space on the CC/RA Form below the last sample number listed on the part of the form where samples are listed.

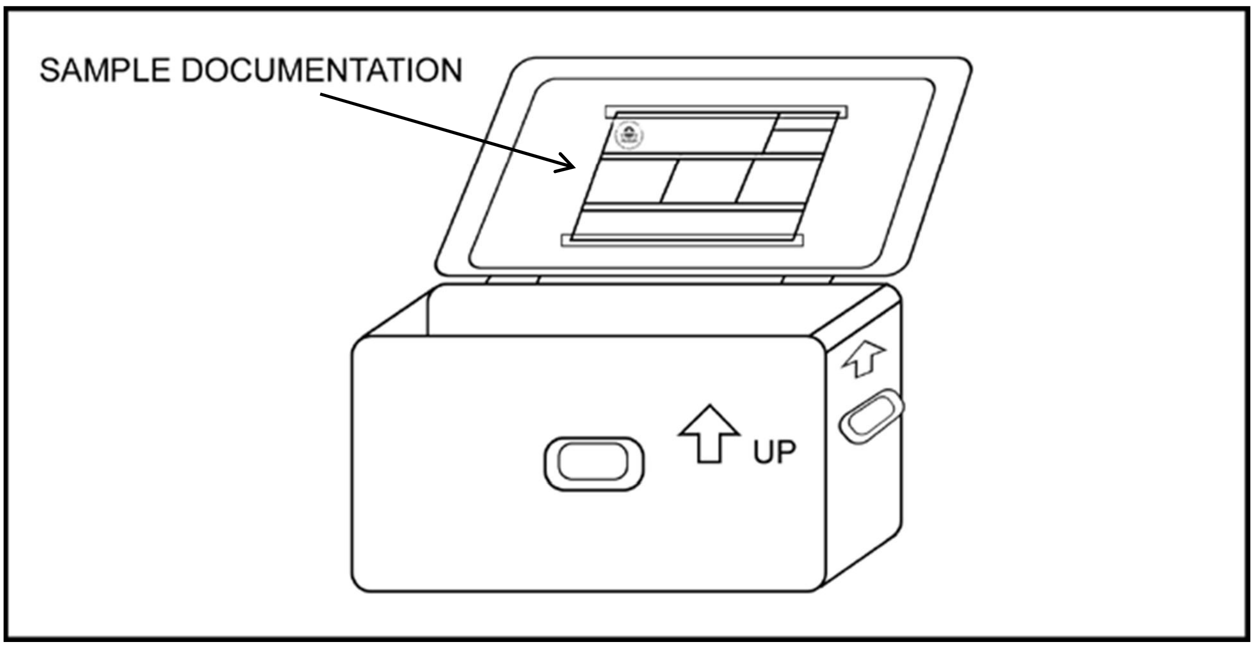
The sampling personnel whose signature appears on the CC/RA Form is responsible for the custody of a sample from time the sample is collected until the custody of the sample is transferred to a designated laboratory, a courier, or to another Tetra Tech employee for transporting a sample to the designated laboratory. A sample is considered to be in custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA Form under "Relinquished by" and "Received by" or a sample is left at a FedEx facility pending shipment. Signatures, printed names, company names, and date and time of custody transfer are required. When custody is transferred, the Tetra Tech sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the CC/RA Form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA Form. Receipts of Bills of Lading will be retained as part of the permanent documentation in the Tetra Tech project file.

FIGURE 3

EXAMPLE OF A SAMPLE COOLER WITH ATTACHED DOCUMENTATION

Place the necessary paperwork (chain-of-custody form, cooler return instructions, and associated paperwork) in the shipping cooler or acceptable container. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping container lid.



Source: U.S. Environmental Protection Agency. 2011.

FIGURE 4

EXAMPLE OF A CUSTODY SEAL

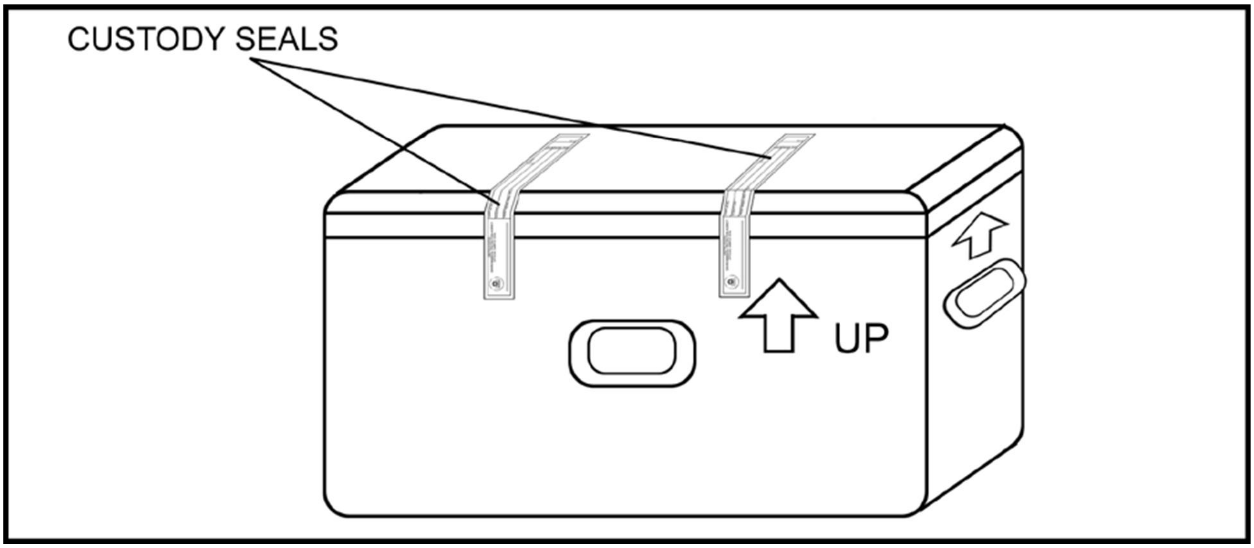
CUSTODY SEAL

Date ______________________________

Signature ___________________________

FIGURE 5

EXAMPLE OF SHIPPING COOLER WITH CUSTODY SEALS



Source: U.S. Environmental Protection Agency. 2011.

Please note that the two seals typically are affixed *to opposite sides of the cooler and offset from each other*, although the offset is not depicted on the EPA figure above.

SOP APPROVAL FORM

TETRA TECH, INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

RECORDING NOTES IN FIELD LOGBOOKS

SOP NO. 024

REVISION NO. 2

Last Reviewed: November 2014

Carla J Buriks

______________________________	November 24, 2014
Quality Assurance Approved	Date

1.0 BACKGROUND

Complete and accurate field documentation is critical to a successful project and the field log book is an important tool to support field documentation needs. The field logbook should include detailed records of all field activities, document interviews with people, and record observations of conditions at a site. Entries should be described in a level of detail to allow personnel to reconstruct, after the fact, activities and events that occurred during their field assignments. Furthermore, entries should be limited to facts. Avoid speculation related to field events and do not record hearsay or unfounded information that may be presented by other parties during field activities. For example, do not record theories regarding the presence or absence of contamination when you are collecting field screening data or speculation regarding the reasons for a property owner's refusal to grant access for sampling.

Field logbooks are considered accountable documents in enforcement proceedings and may be subject to review. Therefore, the entries in the logbook must be accurate and detailed, but should not contain speculative information that could conflict with information presented in subsequent project deliverables and correspondence. Also be aware that the field logbooks for a site may be a primary source of information for depositions and other legal proceedings that may occur months or years after field work is complete and long after our memories have faded. The accuracy, neatness, and completeness of field logbooks are essential for recreating a meaningful account of events.

1.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide guidance to ensure that field logbook documentation collected during field activities meets all requirements for its later use. Among other things, field logbooks may be used for:

- Identifying, locating, labeling, and tracking samples
- Recording site activities and the whereabouts of field personnel throughout the day
- Documenting any deviations from the project approach, work plans, quality assurance project plans, health and safety plans, sampling plans, and any changes in project personnel
- Recording arrival and departure times for field personnel each morning and evening and weather conditions each day
- Describing photographs taken during the project.

In addition, the data recorded in the field logbook may later assist in the interpretation of analytical results. A complete and accurate logbook also aids in maintaining quality control, because it can verify adherence to project scope and requirements.

1.2 SCOPE

This SOP establishes the general requirements and procedures for documenting site activities in the field logbook.

1.3 DEFINITIONS

None.

1.4 REFERENCES

Compton, R.R. 1985. *Geology in the Field*. John Wiley and Sons. New York, NY.

1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Field logbooks
- Ballpoint pens or Sharpies with permanent waterproof ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water-resistant and acid-proof covers, and each page should have preprinted lines, numbered pages, and a single column. They should be approximately $7^1/_2$ by $4^1/_2$ inches or $8^1/_2$ by 11 inches in size. Loose-leaf sheets are not acceptable for use as field notes.* If notes are written on loose paper, they must be transcribed as soon as possible into a bound field logbook by the same person who recorded the notes originally. **Note: Data collection logs and field forms used to record field measurements and data are acceptable as loose-leaf sheets maintained in a three-ring binder with numbered pages.*

Ideally, distribution of logbooks should be controlled by a designated person in each office. This person assigns a document control number to each logbook, and records the assignment of each logbook distributed (name of person, date distributed, and project number). The purpose of this procedure is to ensure the integrity of the logbook before its use in the field, and to document each logbook assigned to a project. In the event that more than one logbook is assigned to a project, this process will ensure that all logbooks are accounted for at project closeout.

2.0 PROCEDURES

The following subsections provide general guidelines and formatting requirements for field logbooks, and detailed procedures for completing field logbooks.

2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites (or operable units), designate a separate field logbook for each subsite. Similarly, if multiple activities are occurring simultaneously requiring more than one task leader (well installation, private well sampling, or geophysical survey.), each task leader should maintain a separate field logbook to ensure that each activity is documented in sufficient detail.
- At larger sites, a general field log may be kept at the site trailer or designated field office to track site visitors, document daily safety meetings, and record overall site issues or occurrences.
- Data from multiple subsites may be entered into one logbook that contains only one type of information for special tasks, such as periodic well water-level measurements.
- All logbooks must be bound and contain consecutively numbered pages.
- No pages can be removed from the logbook for any purpose.
- All information must be entered using permanent, waterproof ink. Do not use pens with "wet ink," because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Be sure that all entries are legible. Use print rather than cursive and keep the logbook pages free of dirt and moisture to the extent possible.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective. Avoid speculation that could conflict with information presented in subsequent project deliverables and correspondence (see Section 1.0 above).
- Use military time, unless otherwise specified by the client.
- Include site sketches, as appropriate.
- Begin a new page for each day's notes.
- Include the date at the top of each page.
- At the end of a day, draw a single diagonal line through any unused lines on the page, and sign at the bottom of the page. Note and implement any client specific requirements (for example, some U.S. Environmental Protection Agency (EPA) programs require each logbook page to be signed).

- Write notes on every line of the logbook. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page.
- If a line is left blank for some reason, cross out (with a single line) and initial to prevent unauthorized entries.
- Cross out (with a single line) and initial any edits to the logbook entries. Edits should only be made if the initial entry is illegible or erroneous. Do not make corrections for grammar or style.

2.2 LOGBOOK FORMAT

The layout and organization of each field logbook should be consistent and generally follow the format guidelines presented below. Some clients or contracts may have specific formatting guidelines that differ somewhat from this SOP; review client requirements at the start of the project to help ensure any client-specific guidelines are integrated.

2.2.1 Logbook Cover

Write the following information on the front cover of each logbook using a Sharpie or similar type permanent ink marker:

- Logbook document control number (assigned by issuer)
- "Book # of #" (determined by the project manager if there is more than one logbook for the project)
- Contract and task order numbers
- Name of the site and site location (city and state)
- Name of subsite (or operable unit), if applicable
- Type of activity (if logbook is for specific activity, such as well installation or indoor air sampling)
- Beginning and ending dates of activities entered into the logbook

2.2.2 Inside Cover or First Page

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Tetra Tech project manager and site manager and phone numbers
- Tetra Tech office address

- Client contact and phone number
- Site safety officer and phone number
- Emergency contact phone number (911, if applicable, or nearest hospital)
- Subcontractor contacts and phone numbers
- Site property owner or property manager contact information

2.3 ENTERING INFORMATION IN THE LOGBOOK

The following lists provide guidance on the type of information to be included in a typical field logbook. This guidance is general and is not intended to be all-inclusive. Certain projects or clients may specify logbook requirements that are beyond the elements presented in this SOP.

General Daily Entries:

- Document what time field personnel depart the Tetra Tech office and arrive at the hotel or site. If permitted by the client to charge travel time for site work, document what time personnel leave and arrive at the hotel each day. (This information may be needed at remote sites where hotel accommodations are not near the site.)
- Indicate when all subcontractors arrive and depart the site.
- Note weather conditions.
- Include the date at the top of each page.
- Document that a site safety meeting was held and include the basic contents of the meeting.
- List the level of protection to be used for health and safety.
- Summarize the day’s planned activities.
- Summarize which activities each field team member will be doing.

Field Activity Entries:

- Refer to field data collection forms for details about field data collection activities (for example time, date, depth of samples, field measurements). If separate field sampling sheets are not used, see section below regarding logbook entries for sampling activities.
- Refer to well purge forms, well construction logs, and other activity-specific forms as applicable rather than including this type of information in the field logbook. These other forms allow the information to be more accessible at a later date.
- List any air monitoring instrumentation used, with readings and locations.
- Refer to instrument field logs for equipment calibration information.
- Summarize pertinent conversations with site visitors (agency representatives, property owners, client contacts, and local citizens).
- Summarize any problems or deviations from the quality assurance project plan (QAPP) or field sampling plan.
- Document the activities and whereabouts of each team member. (As indicated in Section 2.1, multiple logbooks may be required to ensure sufficient detail for contemporaneous activities).
- Indicate when utility clearances are completed, including which companies participated.
- Indicate when verbal access to a property is obtained.
- Include names, addresses, and phone numbers of any pertinent site contacts, property owners, and any other relevant personnel.
- Document when lunch breaks or other work stoppages occur.
- Include approximate scale for all diagrams. If a scale is not available, write “not to scale” on the diagram. Indicate the north direction on all maps and cross-sections, and label features on each diagram.

Sampling Activity Entries: The following information should typically be on a sample collection log and referenced in the log book. If the project does not use sample sheets as a result of project-specific requirements, this information should be included in the logbook.

- Location description
- Names of samplers
- Collection time
- Designation of sample as a grab or composite sample
- Type of sample (water, sediment, soil gas, or other medium)
- On-site measurement data (pH, temperature, and specific conductivity)

- Field observations (odors, colors, weather)
- Preliminary sample description
- Type of preservative used.
- Instrument readings, if applicable

Closing Daily Entries:

- Describe decontamination procedures (personnel and equipment).
- Describe handling and disposition of any investigation-derived wastes.
- Summarize which planned activities were completed and which ones were not.
- Note the times that personnel depart site for the day.
- Summarize any activities conducted after departing the site (paperwork, sample packaging, etc.). This may be required to document billable time incurred after field activities were completed for the day.

Photographic Log Entries:

- For digital photographs, indicate in the text that photographs were taken and the location where the photographs can be found (for example, in the project file).
- Camera and serial #
- Photographer
- Date and time of photograph
- Sequential number of the photograph and the film roll number or disposable camera used (if applicable)
- Direction of photograph
- Description of photograph

2.4 LOGBOOK STORAGE

Custody of logbooks must be maintained at all times. During field activities, field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession. When the field work is over, the logbook should be included in the project file, which should be in a secured file cabinet. The logbook may be referenced in preparing subsequent reports and may also be scanned for inclusion as an appendix to a report. However, it is advisable to obtain direction directly from the client before including the logbook as a report appendix, because its inclusion may not be appropriate in all cases.

2.5 HEALTH AND SAFETY CONSIDERATIONS

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHAs) for a project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment (PPE) necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, project-specific Health and Safety Plan (HASP).

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF GROUNDWATER INDICATOR PARAMETERS

SOP NO. 061

REVISION NO. 2

Last Reviewed: July 2009

Quality Assurance Approved

July 2009
Date

1.0 BACKGROUND

Various water quality monitoring systems can be used for determining groundwater indicator parameters in the field. Commonly measured field indicator parameters include pH, specific conductance, temperature, oxidation-reduction potential (ORP), dissolved oxygen (DO) and turbidity. Groundwater field measurements are typically collected in conjunction with groundwater sampling or monitoring well development (see SOPs 010, 015, and 021).

Various types of water quality systems exist including down-hole systems and flow through cells. Tetra Tech used several common water quality meters including various types of In-Situ, YSI, Hydac, and Horiba meters (see Figure 1 at the end of this SOP). The sampling team should select the type of meter or monitoring system based on site-specific conditions including data collection needs, the types of wells being sampled, and the sampling procedures used. Multiple parameter systems should be used when multiple field parameters are to be measured.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the general requirements and procedures for using various water quality monitoring systems for determining groundwater pH, specific conductance, temperature, ORP, DO and turbidity in the field.

1.2 SCOPE

This SOP applies to general procedures for calibrating and operating water quality monitoring systems in the field. The project work plan or field sampling plan should identify the types of systems to be used and the actual project-specific field parameters to be measured. For each type of water quality system, the manufacturer’s manual should be consulted for specific operating instructions.

1.3 DEFINITIONS

Single Parameter System: A meter or monitoring system consisting of a single probe designed to measure a single indicator parameter.

Multiple Parameter System: A meter or monitoring system consisting of multiple probes capable of measuring multiple indicator parameters.

Open Container Measurements: Field measurements performed in an open container such as a cup, a jar, or a bucket where an air/water interface exists.

Flow-Through Chamber or Cell: A plastic cell or chamber connected to the sample pump discharge tubing so that a continuous flow of water passes across the probes. Additional tubing is used to route water from the flow-through cell to a waste container or final discharge point.

Down-Hole Monitoring System: A meter or monitoring system where probes are submerged by inserting them into the well. The probes are attached to the meter (located at the well head or ground surface) by one or more cables.

pH: A measure of the acidity or alkalinity of a solution. The pH scale ranges from 0 to 14 with strongly acidic solutions at the low end, strongly basic solutions at the high end, and “pure” or neutral water at 7. Field measurements of pH are recorded in standard units.

Specific Conductance: The ability of a solution to conduct electricity; a measure of the solution’s ionic activity and content. The higher the concentration of ionic (dissolved) constituents, the higher the conductivity. Conductivity of the same water changes substantially with temperature. Specific conductivity is generally found to be a good measure of the concentration of total dissolved solids (TDS) and salinity. Conductivity is measured by placing two electrodes (with opposite electrical charge) in the water. For a known electrical current, the voltage drop across the electrodes reveals the solution’s resistance. Since the resistance of aqueous solution changes with temperature (resistance drops with increasing temperature), the resistance is corrected to the resistance of the solution at 25 ºC. Field measurements are recorded in units of microsiemens per centimeters (µS/cm).

Temperature: The degree of hotness or coldness of the solution being measured. Field measurements are typically recorded in degrees Celsius (°C).

ORP: ORP, or redox potential, is the tendency of a chemical species to acquire electrons and be reduced. In aqueous solutions, the reduction potential is the tendency of the solution to either gain or lose electrons when new chemical species are introduced. A solution with a higher (more positive) reduction potential than the new species will have a tendency to gain electrons from the new species (to be reduced by oxidizing the new species) and a solution with a lower (more negative) reduction potential will have a tendency to lose electrons to the new species (to be oxidized by reducing the new species). Just as the transfer of hydrogen ions between chemical species determines the pH of an aqueous solution, the transfer of electrons between chemical species determines the reduction potential of an aqueous solution. Like pH, the reduction potential represents an intensity factor. It does not characterize the capacity of the system for oxidation or reduction, in much the same way that pH does not characterize the buffering capacity. Field measurements are typically recorded in millivolts (mV).

DO: Dissolved oxygen (or oxygen saturation) is a relative measure of the amount of oxygen dissolved or carried in a given medium. In aquatic environments, dissolved oxygen is a relative measure of the amount of oxygen (O_2) dissolved in the water. Field measurements are typically recorded in milligrams per liter (mg/L).

Turbidity: Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids). Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand, very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid. Field measurements are typically recorded in Nephelometric Turbidity Units (NTU).

1.4 REFERENCE

Essential Handbook of Ground-Water Sampling by Gillian Nielsen, 2007.

Tetra Tech EM Inc. July 2009. SOPs 010, 015, and 021

1.5 REQUIREMENTS AND RESOURCES

The following items are typically required to measure groundwater pH, specific conductance, temperature, ORP, DO, and turbidity using this SOP:

- Single or multiple parameter water quality measuring system
- Specific conductance calibration solutions
- Buffer solutions of pH 4, 7, and 10 for pH calibration
- Distilled or deionized water
- Rinse bottle
- 50-milliliter (mL) sample cups or beakers
- Sample tubing and connectors (specific to each type of system)
- Waste container to collect purge water
- Logbook or field data sheets

2.0 PROCEDURES

The procedures outlined in this SOP are general and may apply to various types of water quality monitoring systems to measure groundwater pH, specific conductance, temperature, ORP, DO and turbidity in the field. General procedures for testing and calibrating the monitoring systems are presented first, followed by procedures for using the instruments and making field measurements. Each particular monitoring system should be identified in the project work plan or field sampling plan and should be operated in accordance with the manufacturer’s instruction manual.

2.1 TESTING AND CALIBRATION PROCEDURES

Each field meter or monitoring system should be calibrated according to manufacturer's specifications. In general, equipment should be thoroughly cleaned then calibrated and tested before the start-up of sampling at each site. Equipment should be calibrated and tested using manufacturer provided solutions and standards. Care should be taken to rinse the probes between testing and calibration to prevent cross contaminating solutions. Solutions should be poured from the manufacturer's container into another container to prevent compromising the entire solution provided by the manufacturer. Calibration and testing of field equipment should be documented each time it is performed in field logbooks (or field data sheets, if applicable). If testing and calibration measurements are out of tolerance, the instrument must be serviced or repaired.

2.2 FIELD MEASUREMENT PROCEDURES

Each field meter or monitoring system should be operated according to manufacturer's specifications. The actual field procedures will vary depending on the type of monitoring system being used (open container systems, flow-through cell systems, or down-hole systems) and the types of field parameters being measured. In addition, most systems include a data logging option. A description of open container, flow-through cell, and down-hole measurement processes are discussed below, followed by a general procedural summary and a summary of common errors associated with field measurements of indicator parameters.

2.2.1 Open Container Measurements

Open container measurements consist of collecting groundwater and placing it in a cup or container for field measurements using a hand held system. This method of field measurements is commonly used when bailing wells, but can also be used when pumping wells. Prior to field measurements, the equipment must be cleaned and calibrated following manufacturer's specifications. Field measurements should then be made at the frequency and for the indicator parameters specified in the project work plan or field sampling plan. To make open container field measurements, samplers collect groundwater from the well and place in a cup or container large enough to adequately submerge the probe or probes, as specified in the manufacturer's operations manual. For open containers, measurements should be taken in the following order: temperature, specific conductance, pH, and turbidity. Open container systems are not recommended for low-flow sampling as flow-through systems are more appropriate. The probes and cup or container should be thoroughly rinsed after each field measurement and between sampling locations.

2.2.2 Flow-Through Cell Measurements

Flow-through cell systems consist of measuring groundwater parameters as a continuous flow of water passes across the probes through a cell or chamber, and is primarily used when pumping wells and using low-flow sampling procedures. Prior to field measurements, the equipment must be cleaned and calibrated following manufacturer's specifications. Field measurements should then be made at the frequency and for the indicator parameters specified in the project work plan or field sampling plan.

The flow-through cell or chamber is placed "in line" between the discharge tubing of the pump and the container used to collect purged water. The outlet from the pump must be connected to the sample chamber input. The sample chamber outlet must then be connected or routed to a waste container (or to another designated discharge point). Tubing, fittings, and adaptors are generally required and may be provided by the manufacturer. Pump discharge tubing and chamber inlets and outlets are typically 1/2 or 3/8 inch diameter.

After the cell or chamber is connected to the pump discharge tubing and waste collection container, the sensors should be inserted into the sensor mounting plate in their respective ports. Any unused sensor ports must have plugs installed to close off the sample chamber. The probe cables are then connected to the meter following manufacturer's specifications.

With the system connected, the sampler should turn on the pump according to the manufacturer's instructions and then turn on the water quality monitor. Before recording any values, the sample chamber should be full, all air should be voided, and all of the displayed values should be stable. The probes and sample chamber should be thoroughly rinsed between sampling locations.

2.2.3 Down-Hole Measurements

Down-hole measurement systems consist of inserting the probes (or a multi-parameter sensor housing) inside a well to obtain field measurements, and is primarily used when pumping wells. Prior to field measurements, the equipment must be cleaned and calibrated following manufacturer's specifications.

Field measurements should then be made at the frequency and for the indicator parameters specified in the project work plan or field sampling plan.

The probes or sensor are attached to a hand held meter or control unit by a cable and lowered inside the well to be sampled. Limiting factors when using down-hole systems include probe or sensor diameters and available cable lengths. The probes should be thoroughly decontaminated between sampling locations...

2.2.4 General Procedures for Field Measurements of Indicator Parameters

The following section discusses general procedures that typically apply to making field measurements of indicator parameters using various types of field instruments. Each particular type of meter or monitoring system should be identified in the project work plan or field sampling plan and should be operated in accordance with the manufacturer’s instruction manual.

1. Inspect the instrument and batteries prior to the field effort.
2. Check the integrity of the buffer solutions used for field calibration since frequent replacement is necessary as a result of degradation upon exposure to the atmosphere.
3. If applicable, make sure all electrolyte solutions within the electrode(s) are at proper levels and no air bubbles are present within the electrode(s).
4. Calibrate the meter and electrode(s) on a daily use basis (or as recommended) following manufacturer's instructions and record data in field logbook or on field data sheets.
5. Immerse the electrode(s) in the sample. Stabilization may take several seconds to several minutes. If the parameter values continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be occurring in the sample, or the meter or electrode may be malfunctioning. The failure of the measurements to stabilize should be clearly noted in the logbook or field data sheet. For DO, provide for sufficient flow past the membrane by gently stirring the sample. Probes without stirrers placed in wells (down-hole measurements) may be gently moved up and down to achieve the required mixing.
6. Read and record the value of each parameter being measured making sure units of measure are clearly recorded.
7. Rinse the electrode(s) with deionized water.
8. Store the electrode(s) in accordance with manufacturer’s instructions

2.2.5 Common Errors or Problems Associated With Field Measurements

The project work plan or field sampling plan should clearly identify the types of parameters to be measured, the measurement frequency, and "stabilization" requirements. It is essential to ensure that the type of monitoring system selected is compatible with the monitoring well sampling or development methods to be utilized. Some common errors to avoid are identified below:

- No, or incorrect equipment calibration
- Incorrect or expired calibration standards
- Poor equipment maintenance
- Inadequate training or unfamiliarity with equipment
- No record of units of measure and "+" or "-" values for ORP
- Too much time taken to measure temperature sensitive parameters
- DO and ORP measured in closed systems (flow-through cell or down-hole) instead of closed cell systems

FIGURE 1

THE HORIBA U-10 WATER QUALITY MONITORING SYSTEM
THE IN-SITU TROLL 9500 LOW-FLOW SYSTEM
THE YSI HAND HELD 556 METER

Horiba U-10

In-Situ Troll

YSI 556

ATTACHMENT 1

U.S. Environmental Protection Agency Standard Operating Procedures

1. SESD Operating Procedure 305-R3 (Potable Water Supply Sampling)

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Potable Water Supply Sampling**	
Effective Date: May 30, 2013	**Number:** SESDPROC-305-R3
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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-305-R3, *Potable Water Sampling*, replaces SESDPROC-305-R2 **General:** Corrected any typographical, grammatical and/or editorial errors. **Title Page:** Changed author from Maria Labrador to Mike Neill. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. Section 1.4: Omitted references that were no longer applicable. **Section 2.3**: Reorganized section by adding four subsections: Sample Handling, Sample Preservation, Sample Dechlorination and Other Sample Preservation/Stabilization. Section 2.3.1: Omitted “procedures” and “used” and added “used” in the first sentence. Omitted “labeled” from first sentence of Item 3. Item 4 was added to address samples requiring reduced temperature storage. Section 2.3.2: This section was revised to reflect current preservation practices. Section 2.3.3: The following language was added to create Section 2.3.3: “Potable water samples that have been treated with chlorine require the addition of sodium thiosulfate to dechlorinate the sample.” Section 2.3.4: The following language was added to create Section 2.3.4: “If other preservation or stabilization requirements are needed, refer to the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version.” Section 3.1: The requirements for obtaining the resident’s information were moved to the top of this section. In the first sentence of the next to last paragraph the following language was added: “or the container is pre-preserved.” Section 4: Section was renamed from “Potable Water Supply Sampling Methods – Purging” to “Potable Water Supply Purging.” Section 4.1 and Section 4.1.1: Section 4.1.1 was moved to Section 4.1. Section was renamed from “Purging and Purge Adequacy” to “Potable Wells – Purging and Purge Adequacy.” Language from former Section 4.2 concerning potable water purging from residential wells was relocated to the	May 30, 2013

first and last paragraph of this section. Section 4.2: Previous language was omitted and replaced with language concerning water supply plants and large industrial supplies. Section was renamed to reflect the new subject. Section 4.2: Section was omitted. Section 5.2: Section was renamed from “Collecting Samples from Wells with In Place Plumbing” to “Collecting Samples from Residential Wells.” Section 5.3: Section was renamed from “Sample Preservation” to “Collecting Samples from Water Supply Plants.” The entire section was revised to reflect current practices. Section 5.4: Content from Section 5.4.1 was incorporated into Section 5.4. Sections 5.4.1 and 5.4.2 were omitted. Section 5.5: This section was omitted. Section 5.6: This section was omitted.	
SESDPROC-305-R2, *Potable Water Sampling*, replaces SESDPROC-305-R1	January 29, 2013
SESDPROC-305-R1, *Potable Water Sampling*, replaces SESDPROC-305-R0	November 1, 2007
SESDPROC-305-R0, Potable Water Supply Sampling, Original Issue	February 05, 2007

TABLE OF CONTENTS

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting potable water supply samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling potable water supply samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to obtain a potable water supply sample, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

Puls, Robert W., and Michael J. Barcelona. Filtration of Ground Water Samples for Metals Analysis. *Hazardous Waste and Hazardous Materials* 6(4): 385-393 (1989).

Puls, Robert W., Don A. Clark, and Bert Bledsoe. Metals in Ground Water: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials* 9(2): 149-162 (1992).

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

SESD Operating Procedure for Field pH Measurement, SESDPROC-100, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field Specific Conductance Measurement, SESDPROC-101, Most Recent Version

SESD Operating Procedure for Field Temperature Measurement, SESDPROC-102, Most Recent Version

SESD Operating Procedure for Field Turbidity Measurement, SESDPROC-103, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version.

US EPA. April 13, 1981. Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples. Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273)

US EPA. 1995. Ground Water Sampling - A Workshop Summary. Proceedings from the Dallas, Texas November 30 - December 2, 1993 Workshop. Office of Research and Development Robert S. Kerr Environmental Research Laboratory. EPA/600/R-94/205.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4, SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting potable water supply samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting potable water supply samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Always sample from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location. This minimizes the opportunity for cross-contamination to occur during sampling.
- Collected samples must remain in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal

Regulations (49 CFR Parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.

- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and stored in a secure place.

2 Special Sampling Considerations

2.1 Volatile Organic Compounds (VOC) Analysis

Potable water supply samples for VOC analysis must be collected in 40 ml glass vials with Teflon® septa. The vials may be either preserved with concentrated hydrochloric acid or they may be unpreserved. Preserved samples have a two-week holding time, whereas unpreserved samples have only a seven-day holding time. In the great majority of cases, the preserved vials are used to take advantage of the extended holding time. In some situations, however, it may be necessary to use the unpreserved vials. For example, if the potable water supply has a high amount of dissolved limestone, i.e., is highly calcareous, there will most likely be an effervescent reaction between the hydrochloric acid and the water, producing large numbers of fine bubbles. This will render the sample unacceptable. In this case, unpreserved vials should be used and arrangements must be confirmed with the laboratory to ensure that they can accept the unpreserved vials and meet the shorter sample holding times.

The samples should be collected with as little agitation or disturbance as possible. The vial should be filled so that there is a meniscus at the top of the vial and absolutely no bubbles or headspace should be present in the vial after it is capped. After the cap is securely tightened, the vial should be inverted and tapped on the palm of one hand to see if any undetected bubbles are dislodged. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken not to flush any preservative out of the vial during topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected.

2.2 Special Precautions for Potable Water Supply Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.
- Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, etc., while the other members collect the samples.

- Samplers must use new, verified and certified-clean disposable or non-disposable equipment cleaned according to procedures contained in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), or the SESD Operating Procedure for Field Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compound analyses.

2.3 Sample Handling and Preservation Requirements

2.3.1 Sample Handling

The following should be used when collecting samples from potable water supplies:

- Potable water supply samples will typically be collected from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. Efforts should be made to reduce the flow from either the tap or spigot during sample collection to minimize sample agitation.
- During sample collection, make sure that the tap or spigot does not contact the sample container.
- Place the sample into appropriate containers. Samples collected for VOC analysis must not have any headspace (see Section 2.1, Volatile Organic Compounds Analysis). All other sample containers must be filled with an allowance for ullage.
- Samples requiring reduced temperature storage should be placed on ice immediately.

2.3.2 Sample Preservation

All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection. If preserved VOC vials are used, these will be preserved with concentrated hydrochloric acid by Analytical Support Branch (ASB) personnel prior to departure for the field investigation. ASB personnel will also provide sodium hydroxide tablets to preserve water samples that are being analyzed for cyanide. For all other chemical preservatives, SESD will use the appropriate chemical preservative generally stored in an individual single-use vial as described in the SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011). The adequacy of sample preservation will be checked after the addition of the preservative for all samples except for the samples collected for VOC analysis. Additional preservative should be added to achieve adequate preservation.

2.3.3 Sample Dechlorination

Potable water samples that have been treated with chlorine require the addition of sodium thiosulfate to dechlorinate the sample.

2.3.4 Other Sample Preservation/Stabilization

If other preservation or stabilization requirements are needed, refer to the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version.

2.4 Quality Control

Equipment rinsate blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by any sampling equipment.

2.5 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in the SESD Operating Procedure for Control of Records (SESDPROC-002). Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation in accordance with the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005) and the SESD Operating Procedure for Logbooks (SESDPROC-010).

3 Potable Water Supply Sampling – Sample Site Selection

3.1 General

Obtain or confirm the following information:

- the name(s) of the resident(s) or water supply owner/operator
- the exact physical address
- the exact mailing address (if different from the physical address)
- the resident's/operator's home, work and mobile telephone numbers (when available)

The information is required so that the residents or water supply owner/operators can be informed of the results of the sampling program.

The following should be considered when choosing the location to collect a potable water sample:

- Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest.

- Whenever possible, choose the tap closest to the water source, and prior to the water lines entering the residence, office, building, etc., and also prior to any holding or pressurization tanks.

- The sampling tap must be protected from exterior contamination associated with being too close to a sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collection procedure since it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. If the tap is too close to the ground for direct collection into the appropriate container, it is acceptable to use a smaller container to transfer sample to a larger container. The smaller container should be made of glass or stainless steel, and should be decontaminated to the same standards as the larger container.

- Leaking taps that allow water to discharge from around the valve stem handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations.

- Disconnect any hoses, filters, or aerators attached to the tap before sampling. These devices can harbor a bacterial population if they are not routinely cleaned or replaced when worn or cracked.

- Taps where the water flow is not constant should be avoided because temporary fluctuation in line pressure may cause clumps of microbial growth that are lodged in a pipe section or faucet connection to break loose. A smooth flowing water stream at moderate pressure without splashing should be used. The sample should be collected without changing the water flow. It may be appropriate to reduce the flow for the volatile organic compounds aliquot to minimize sample agitation.

Occasionally, samples are collected to determine the contribution of system-related variables (e.g., transmission pipes, water coolers, water heaters, holding tanks, pressurization tanks, etc.) to the quality of potable water supplies. In these cases, it may be necessary to ensure that the water source has not been used for a specific time interval (e.g., over a weekend or a three- or four-day holiday period). Sample collection may consist of collecting a sample of the initial flush, collecting a sample after several minutes, and collecting another sample after the system being investigated has been completely purged.

When sampling for bacterial content or the container is pre-preserved, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the thiosulfate dechlorinating agent (if used). When filling any sample container, care should be taken that splashing drops of water from the ground or sink do not enter into either the bottle or cap.

When sampling at a water treatment plant, samples are often collected from the raw water supply and the treated water after chlorination.

4 Potable Water Supply– Purging

4.1 Potable Wells - Purging and Purge Adequacy

Wells with in-place plumbing are commonly found at residences. The objective of purging wells with in-place pumps is the same as with monitoring wells without in-place pumps, i.e., to ultimately collect a water sample representative of aquifer conditions.

Purging is the process of removing stagnant water immediately prior to sampling. In order to determine when an adequate purge has occurred, field investigators should monitor the pH, specific conductance and turbidity of the water removed during purging. For potable water supply sampling, it is recommended to purge the system for at least 15 minutes when possible.

An adequate purge is achieved when the pH and specific conductance of the potable water have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs). Although 10 NTUs is normally considered the minimum goal for most water sampling objectives, lower turbidity has been shown to be easily achievable in most situations and reasonable attempts should be made to achieve these lower levels. Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU) and the specific conductance varies no more than approximately 10 percent. There are no set criteria establishing how many total sets of measurements are adequate to document stability of parameters.

If, after 15 minutes, the in situ chemical parameters have not stabilized according to the above criteria, additional water can be removed. If the parameters have not stabilized after 15 minutes, it is at the discretion of the project leader whether or not to collect a sample or to continue purging.

A well with an intermittently run pump should, in all respects, be treated like a well without a pump. In these cases, parameters are measured and the well is sampled from the pump discharge after parameter conditions have been met. Generally, under these conditions, 15 to 30 minutes will be adequate.

4.2 Water Supply Plants

Municipality water supply plants and large industrial supplies that operate continuously, require no purge other than opening a valve and allowing it to flush for a few minutes. If a storage tank is present, a spigot, valve or other sampling point should be located between the pump and the storage tank. If not, locate the valve closest to the tank. Measurements of pH, specific conductance and turbidity are recorded at the time of sampling when water quality parameters are required.

4.3 Investigation Derived Waste

Purging generates quantities of purge water or investigation derived waste (IDW), the disposition of which must be considered. See the SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for guidance on management or disposal of this waste.

5 Potable Water Supply Sampling Methods – Sampling

5.1 General

Sampling is the process of obtaining, containerizing, and preserving (if required) a potable water supply water sample after the purging process is complete. It is recognized that there are situations, such as industrial or municipal supply wells or private residential wells, where a well may be equipped with a dedicated pump from which a sample would not normally be collected. Discretion should always be used in obtaining a sample.

5.2 Collecting Samples from Residential Wells

Samples should be collected following purging from a valve or cold water tap as near to the well as possible, preferably prior to any storage/pressure tanks or physical/chemical treatment system that might be present. Remove any hose that may be present before sample collection and reduce the flow to a low level to minimize sample disturbance, particularly with respect to volatile organic constituents. Samples should be collected directly into the appropriate containers (see the ASBLOQAM for a list of containers). It may be necessary to use a secondary container, such as a clean 8 oz. or similar size sample jar or a stainless steel scoop, to obtain and transfer samples from spigots with low ground clearance. All measurements for pH, specific conductance and turbidity should be recorded at the time of sample collection.

1. Ideally, the sample should be collected from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. If the sample must be collected at a point in the water line beyond pressurization or holding tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and at the location where the sample is collected. If the sample is collected from a tap or spigot located just before a storage tank, spigots located inside the building or structure should be turned on to prevent any backflow from the storage tank to the sample tap or spigot. It is generally advisable to open several taps during the purge to ensure a rapid and complete exchange of water in the tanks.

2. Purge the system for at least 15 minutes when possible. During the purge period, obtain at least three sets of readings as follows: after purging for several minutes, measure the pH, specific conductivity and turbidity of the water. Continue to measure these parameters to assess for stabilization.

3. After three sets of readings have been obtained, samples may be collected. If stabilization has not occurred after the 15-minute purge period, it is at the discretion of the project leader to collect the sample or continue purging and

monitoring the parameters. This would depend on the condition of the system and the specific objectives of the investigation.

5.3 Collecting Samples from Water Supply Plants

Municipality water supply plants and wells that continuously operate, require no purge other than opening a valve and allowing it to flush for a few minutes. If a storage tank is present, a spigot, valve or other sampling point should be located between the pump and the storage tank. If not, locate the valve closest to the tank. Measurements of pH, specific conductance and turbidity are recorded at the time of sampling when water quality parameters are required.

5.4 Special Sample Collection Procedures

Special sample handling procedures should be instituted when trace contaminant samples are being collected. All sampling equipment which comes into contact with the water must be cleaned in accordance with the cleaning procedures described in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination, (SESDPROC-205) or the SESD Operating Procedure for Field Cleaning and Decontamination at the FEC (SESDPROC-206), as applicable.